CREATION OF WETLAND HABITAT IN NORTHEASTERN ILLINO

DOCUMENT NO. 82/(

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Illinois Department of
Energy and Natural Resourc

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DOC. NO. 82/09
May, 1982

CREATION OF WETLAND HABITATS IN NORTHEASTERN ILLINOIS

by

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1) Done under contract from the Illinois Department of Energy and Natural Resources as Project Number 20.146 to Resource Associates, 53 W. Jackson Blvd., Chicago, in association with the Open Lands Project and the Kropp Company.

Printed by Authority of the State of Illinois

Quantity Printed: 250

Date Printed: June 1982

This report has been reviewed by the Department of Energy and Natural Resources and approved for publication. Views expressed are those of the contractor and do not necessarily reflect the position of DENR.

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ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of the Lake County Forest Preserve District. Superintendant Jerrold Soesbe and his staff Dan Brouillard and Dennis Laurie guided the project team in site selection and provided data for the site inventory. Their interest and cooperation were essential.

David Jones, Department of Energy and Natural Resources, was project manager for this work. His involvement began in the conceptual stage and continued through field work and completion. His overview and enthusiasm were valued.

Field visits outside the region were made most profitable by Jim Zimmerman who joined the project team in Dane County, Wisconsin and provided useful insights as well as his time.

CHAPTER I
An Introduction to Wetland Restoration

The streams in northeastern Illinois, as in much of the upper Midwest, were originally shallow, slow-moving, and meandering. In particularly low-lying areas the streams often dispersed into marshy wetland areas which supported lush vegetation affording abundant and diverse wildlife habitats. In many cases the river's edge and its floodway formed a ribbon of wetland, and the more extensive floodplain lands adjacent to the streams were moist meadow areas. The variety of water-adapted lands provided many positive benefits: at times of flood, water was stored and slowly released; the streams had a built-in capacity to cleanse their waters; runoff entering the stream laterally was cleansed as it filtered through the floodplain meadows and the marsh complexes which provided diverse habitat.

Today, virtually all streams in northeastern Illinois have been modified to adapt their drainage characteristics in support of either agricultural or urban development. The modifications, such as channelization and floodplain filling have resulted in the decimation of the riverine wetlands with accumulations of spoil along the river banks often screening the stream from view. The resulting stream channels are narrower, their banks are steeper, and floodplains are no longer moist meadows. Quite clearly, the stream systems of northeastern Illinois have been fatally compromised (Forbes and Richardson, 1919; Mills et. al., 1966; and Bellrose et. al., 1979). The natural filtering capacity of the stream has been all but eliminated and the restricted conditions provide a very limited range of vegetation, fish and wildlife. Carp, a non-native fish closely associated with pollution, is one of the few species that can survive in these highly engineered, modern streams despite the improvement

in water quality of recent years. Figure 1 indicates the changes that take place in streams as channelization and draining of wetlands occur.

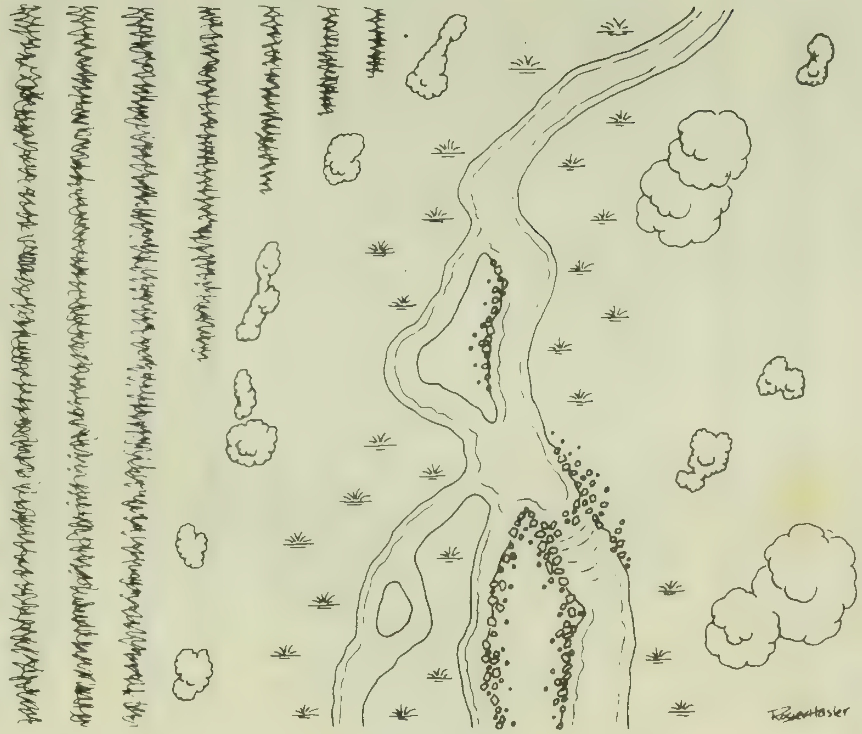
In the last decade, a great deal of attention has been focused on the quality of water in streams and rivers. Massive public and private investments have been made to provide cleaner water, particularly in Illinois' urban regions, in the hope that the displaced life would return. This has not happened. The environmental, social, and economic benefits which could come from the control of municipal, industrial, and agricultural wastewater are not being fully realized. The accrued benefits are in no way commensurate with the investments. Although a considerable effort has been made to provide water quality suitable for a healthy aquatic environment, the desired result has not been obtained because little has been done to maintain or improve the physical habitat essential for sustaining wildlife. Insignificant consideration has been given to public access to rivers and streams for enjoyment. Many streams in northeastern Illinois are still flowing through uninhabitable, unappealing, and inaccessible channels, even though water quality has been improved.

The past management strategy has been predicated on the assumption that goals for clean water can be achieved through treating urban and industrial wastes by conventional engineering. This technology requires that wastewaters be gathered through sewer collection systems and treated at a central location. Today, it is becoming apparent that this strategy has two major limitations. First, because of the higher and higher degree of treatment required, the approach has become exceedingly expensive. Second, it is now recognized that there are many contaminants which limit the quality and use of our streams which cannot easily be directed to a central facility. These are

FIGURE 1 : NATURAL AND MAN - MADE STREAM CHANNELS

A : NATURAL

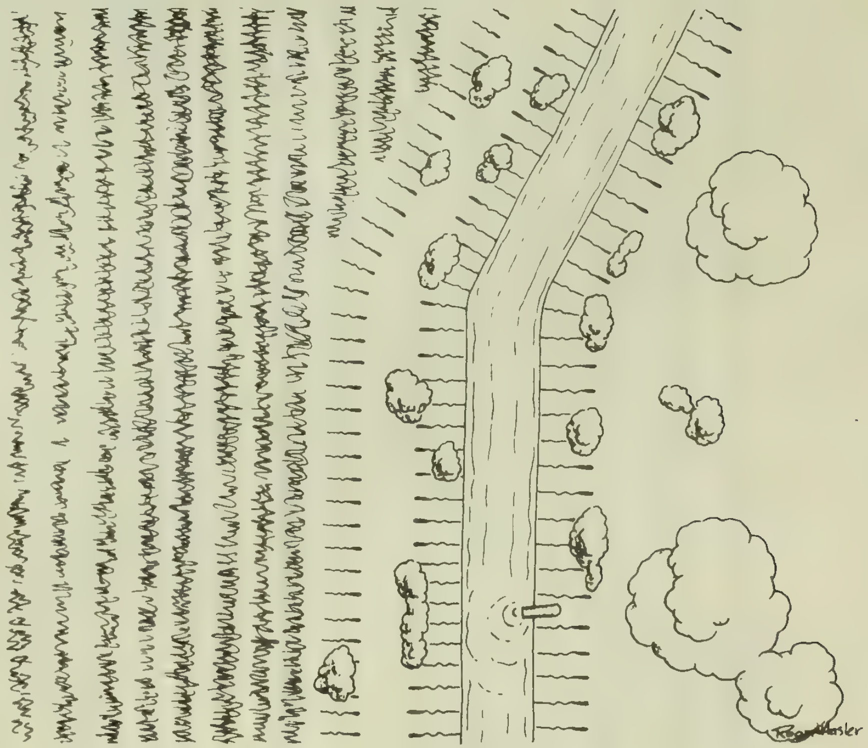
Sectional View



Plan View

B : MAN - MADE

Sectional View



Plan View

termed non-point source pollutants. They are found in the runoff from streets, roads, highways and agricultural drainage. They find their way to streams and rivers during and immediately following rainfall. The quantity and strength of contaminants in non-point source runoff can be as great and often greater than in conventional treatment plant effluent. Non-point source runoff is rich in oxygen-demanding wastes, heavy metals and silt. Lacking the filtering capacity of wetlands these contaminants find their way into the stream as directly as if they were discharged through a sewer. Traditional wastewater treatment systems cannot treat the non-point source contaminants. Alternative, cost effective systems must be conceived and evaluated. Wetlands are one such alternative.

The first goal of this work is to address the problems outlined above and summarized below:

1. loss of wetland and aquatic habitats
2. less flood water storage
3. treatment of non-point source pollution
4. cost of high technology, advanced wastewater treatment
5. limited use and enjoyment of cleaner streams

The second goal is to investigate the role of reintroduced wetlands as a potential solution to these universal urban problems. A conceptual plan is proposed for wetland restoration on a specific site along the Des Plaines River in northeastern Illinois. One small site, of course, cannot possibly change the character of the entire river; nevertheless, it can demonstrate that even a relatively small restoration can bring about improvement.

In several areas of the country, existing wetlands have been used to treat municipal wastewater and it has been found that they can achieve high pollutant

removal efficiencies. Unfortunately, there is little information available on constructed wetlands. However, a recent report by the U.S. Environmental Protection Agency (Reed and Bastian, 1980), stated that the use of constructed wetlands has greater promise for general application than the use of existing wetlands. The report recommended that reliable engineering criteria need to be developed and that "real world" operating information be obtained from a number of large scale reconstructed wetland systems installed in a variety of geographic locations so that regionally applicable criteria could be developed.

This work has developed the conceptual plan for a constructed wetland. In fact, what is proposed is a reconstructed wetland, for as far as the records indicate, the selected site was once, in part, a natural wetland that has been drained and the river channel altered. The proposed plan would reinstitute the wetland by rebuilding the river channel, by irrigating the floodplain with river water to create a moist environment, and by introducing a variety of appropriate plants to create diverse habitat.

Existing wetlands and their inhabitants are decimated annually. It was the third goal of this work to create a system which preserves as many as possible of these ever more rare wetland inhabitants. In the future there could well be a time when the local native species needed to create wetland communities do not exist naturally. Then the importance of diverse, reconstructed wetland systems will be even greater.

This study was divided into several phases. A literature search was conducted and two approaches were taken. The first was the search of available computerized environmental data bases. This yielded some 270 publications from which 14 were selected for further consideration. The second approach involved per-

sonal contact with researchers in the field whose names were selected from the computerized literature search as well as other sources.

Following the literature search, site selection and regional field visits were undertaken. Criteria for site selection were developed. These generally favor disturbed sites which could be enhanced by creating wetland habitats which would, in turn, beneficially affect water quality, flooding, and depauperate habitats. Once the criteria were developed, various sites were visited and the final site selected.

Further field visits were conducted outside the region to examine existing functioning wetlands. The project team traveled to Dane County, Wisconsin to inspect five wetlands of great interest because of their proximity to urban development and the similarity of their site conditions to wetlands found in northeastern Illinois. A project team member attended the Midwest Conference on Wetland Value and Management held in St. Paul, Minnesota, June 1981. This conference affirmed the approach to water treatment through wetland management.

The selected site was carefully examined during the summer of 1981 and inventories were made for landforms, soils, hydrology, water quality, vegetation, wildlife, public access and public use. These served as the basis of the conceptual plan. The plan for wetland restoration proposes alteration of the existing form of the river channel and reintroduction of a variety of native wetland vegetation; and, perhaps most importantly, it calls for the effects of the wetland to be monitored in terms of water quality, natural habitats, flooding and public use. It is the project team's belief that this range of benefits can be provided for construction and management costs that are less than one half those of conventional wastewater treatment.

CHAPTER II

Site Selection

The site for the proposed wetland restoration was chosen carefully with characteristics of the stream, the land, and the land use all being considered. For each of these a check list of desirable criteria was developed for use in both the field work and final selection. Review of stream characteristics included river stage magnitude and source of streamflow, water quality, channel conditions, and aquatic life. Criteria considered germane to the land were geology, topography, soil, vegetation, wildlife, man-made changes, land area, and configuration of the site and surroundings. Land use characterisitics included land ownership, past and present land uses, future plans, adjacent land uses, visibility, public access, and existing recreational use.

Taking stream characteristics first, it was felt that a section along the main stem of one of the principal rivers in the Chicago metropolitan region would be more desirable than a section along a tributary, since the main stem would have greater and more dependable flow, making for greater potential impacts by the proposed wetland. While all the stream water in the region has been affected to some degree by surrounding urbanization, the extent can vary. It was felt desirable to select poor quality water, based largely on visual characteristics of the water rather than chemical analysis, and to choose a reach with known treatment plant effluent constituting part of the flow along with urban and agricultural runoff. However, going to the extreme of seeking very poor quality was ruled out because of the potential toxicity to the newly established wetland vegetation. Streams with extremes of flow -- either long periods of no flow or unusually high flows -- were avoided, as were sites where wetland development would interfere with flood control plans. Potential

effects of flow alteration on upstream and downstream water users were also reviewed. Since one of the purposes of the wetland restoration is to address the sterile, man-made channel conditions of the streams in the region, a site exhibiting these problems was considered desirable. Thus, deep, steep-sided dredged channels with spoil deposits on banks supporting a degraded vegetation mix were features that were sought; high priority was also accorded to poor chemical and physical qualities of bottom materials. Following this same pattern, poor quality aquatic life indicated by low species diversity of fish, insects and algae, with few native species, was considered desirable. If, however, unusual native species were found, a site would be eliminated from consideration unless protection could be insured during the restoration.

Since the once prevalent wetlands of northeastern Illinois existed because of the favorable natural characteristics, many of the land characteristics required for site selection are common in the region. The virtually ubiquitous mantle of glacial drift provides a desirable substrate allowing free drainage. Sites with shallow depth to bedrock were eliminated from consideration. Topographic characteristics of low relief with floodplains of gentle longitudinal and latitudinal slope were given high priority, as were sites which had formerly been wetlands. As with aquatic characteristics, low species diversity in vegetation and wildlife was considered desirable. Acreage requirements were given serious consideration; a small area (less than 50 acres) would be less costly to restore to wetland and, in many ways, easier to manage; however, the impact of so small an area on the flow of a main stem stream would hardly be significant. On the other hand, a large acreage (over 500 acres) would be expensive to reconstruct as a wetland demonstration and questionable particularly because many of the revegetation constraints are as yet unknown. A manage-

able site was considered to be between 200 and 500 acres with a broad configuration providing ample floodplain land for the lateral redirection of flow.

The first and most important land use characteristic considered was land ownership. Ownership by a public land holding agency is more appropriate to the goals of habitat improvement and increased recreational use. It was also considered desirable that the current land use be as devoid of development as possible to avoid the loss of investment or income. Former land uses were also included as criteria and if a site was disturbed it would have high priority. Another necessary requirement was that no development plans exist. The construction of the wetland, involving as it will considerable earth moving, made a site's adjacent land uses important features, with neighboring residential uses ranked low, and vacant or natural areas most desirable. Visibility was another factor included, given the usual public reaction to disturbance on public land. However, the necessity of direct access to a site during wetland construction and afterwards for public use made total seclusion impractical. The current level of recreational use was a final consideration, since the potential site would be public land. Were a heavily-used site to be selected, displacement during construction would not be popular, so it was decided that a site with current low use but with greater potential use would be very suitable.

With all these criteria and priorities in mind, the site selection process was begun in discussion with local officials and the Lake County Forest Preserve District. Appropriate sites were designated for consideration and repeated field visits preceded the final selection analysis. Not all of the ideal features could be encompassed by a single site so in the selection process, some of the priorities were changed; for example, the Forest Preserve

District staff saw no problem with a visible site; prominance was welcome since they felt that the public would be interested in such a project of improvement. The selected site, therefore, displays a good many of the ideal criteria but not all. Nevertheless, the foregoing discussion presents all the criteria considered important by the project team and can serve to assist other efforts in wetland restoration.

A significant proportion of land held by forest preserve districts in the Chicago metropolitan area is adjacent to the major streams, having been acquired with thought to multiple benefits: decreased flood problems, land and water-based recreation possibilities, and resource preservation. Much of this floodplain was once wetland that has subsequently been drained. Very few of the river channels are in their natural state. The Lake County Forest Preserve District has, over the past ten years, acquired considerable acreage along the Des Plaines River.

This stream rises in southeast Wisconsin and flows directly south, parallel to Lake Michigan's shoreline, flowing west of Chicago to join the Kankakee River, and they become the Illinois River just southwest of Joliet. The Des Plaines valley runs the length of Lake County from north to south. The Lake County Forest Preserve District has demonstrated interest in wetland restoration by recently undertaking some small-scale work. The District was agreeable to review of its floodplain holdings as potential sites. Six areas were selected and field visits were conducted to make closer comparisons. Finally, after analysis of the relative benefits, one site was selected for this proposed wetland restoration project.

The site is in the northern third of Lake County, along the Des Plaines

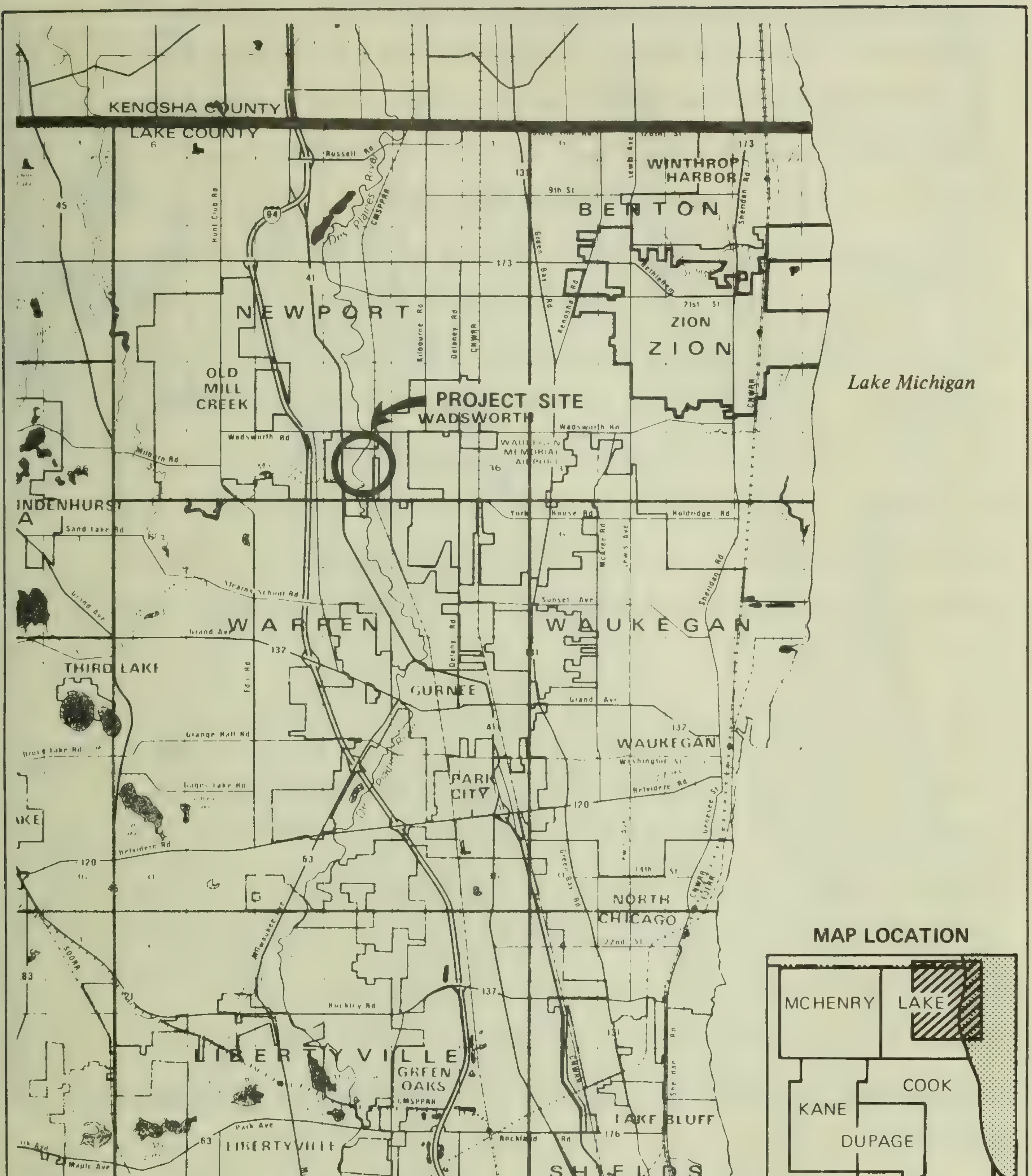
River, and includes the confluence of a tributary, Mill Creek. The site satisfies most of the criteria mentioned above. The water quality of the stream, while not the worst in the region, is poor and, significantly, is visually unappealing. Agricultural and urban runoff enter the river and Mill Creek's flow is partially composed of treatment plant effluent. At the site, the Des Plaines River normally maintains flow throughout the year although it is much reduced from late September through October. Since the channel and the floodplain in this reach have been physically altered by a variety of factors, both aquatic and terrestrial life show limited diversity. The site is underlain by glacial till and its topography is gentle. The site's 450 acres are one unit of a series of holdings which together form the Forest Preserve District's Des Plaines River Trail. The District has not yet fully developed these lands, and, while the site is currently accessible and is used recreationally, such use is limited. Wetland restoration could offer much to the area in positive effects for habitat development, recreational opportunities, aesthetic enjoyment, water quality improvement and flood water detention.

CHAPTER III
Site Inventory

The project site is 42 miles north northwest of Chicago. The city of Waukegan is immediately to the east and the communities of Gurnee and Libertyville immediately to the south. The regional location of the site is shown in Figure 2. Wadsworth Road forms the northern boundary; the Chicago, Milwaukee, St. Paul and Pacific Railroad right-of-way forms the eastern boundary; and U.S. Highway 41 forms the western boundary. The site is located approximately 100 miles upstream of the mouth of the Des Plaines River. Traversing the upper third of the site is an abandoned road, Town Line Road (also called McCarthy Road) which serves rural inhabitants of the area and, more recently, gravel mining activities. The southern and western areas are mining wastelands of talus and water filled pits. The middle portion of the site is abandoned farmland with remnants of past agricultural activities still in evidence in the form of weathered furrows and field hedgerows. In the northwest part of the site, some degraded wetlands have re-established themselves along the Des Plaines River floodplain.

The site has been subjected to major cultural disturbances since the late 1860s. It was reported then that the Des Plaines River near Libertyville abounded "...in deep and shady pools... the ground to the west of the river is a beautiful rolling prairie, that to the east being rougher and originally covered with a dense forest, a considerable portion of which still remains in its primitive form..." (Libertyville, 1946). Shortly after these observations were made, a good many changes occurred to the Des Plaines River, its watershed and the project site. As was noted by

FIGURE 2 : REGIONAL LOCATION OF PROJECT SITE



early observers (Illinois Department of Public Works and Buildings, 1921; Goldthwait, 1909) the drainage of wetlands and the clearing away of forest detrimentally affected the quality, quantity, and distribution of runoff and streamflow. No longer is there a rolling prairie on the west bank of the Des Plaines River. The numerous wetlands reported (Goldthwait, 1909) to have existed along the river in Lake County have been almost completely eliminated. Those small wetland areas that exist on the site today do so only because agricultural drains are no longer maintained. The highway and railroad embankments effectively cut off the lateral surface and groundwater flow needed to recharge and sustain the wetlands. The railroad embankment blocks or diverts water from the east allowing it to enter the site only through two culverts. From the west, the highway disrupts natural drainage but six culverts allow water to flow onto the site.

There is no record available of the site's presettlement condition although Figure 3 gives a general indication of the vegetation types in Lake County in those early days. The first site detail available, shown in Figure 4, was taken from 1946 aerial photographs. By this point there already had been considerable change in the natural landscape caused by the construction of the railroad, Route 41, Wadsworth Road, and Town Line Road (McCarthy Road). Gravel mining had begun at the pit north of Town Line Road at Route 41. The river lands were in agricultural production as well, although much of the land was still subject to seasonal flooding. By 1976 farming had ceased and continued gravel mining had made considerable changes in the land's configuration including the three major gravel pit lakes shown in Figure 5. The river's

FIGURE 3 : PRESETTLEMENT VEGETATION OF LAKE COUNTY, ILLINOIS

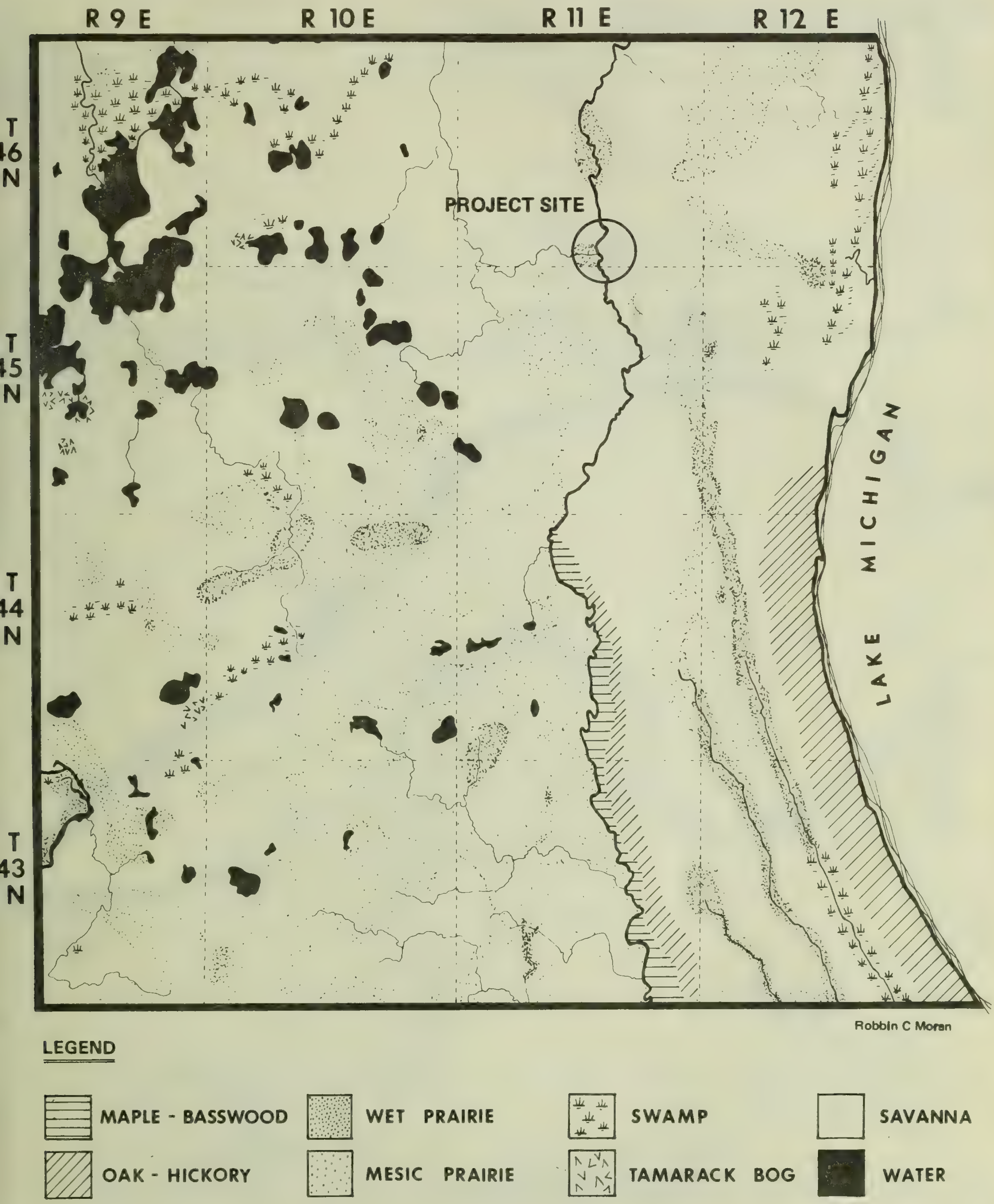
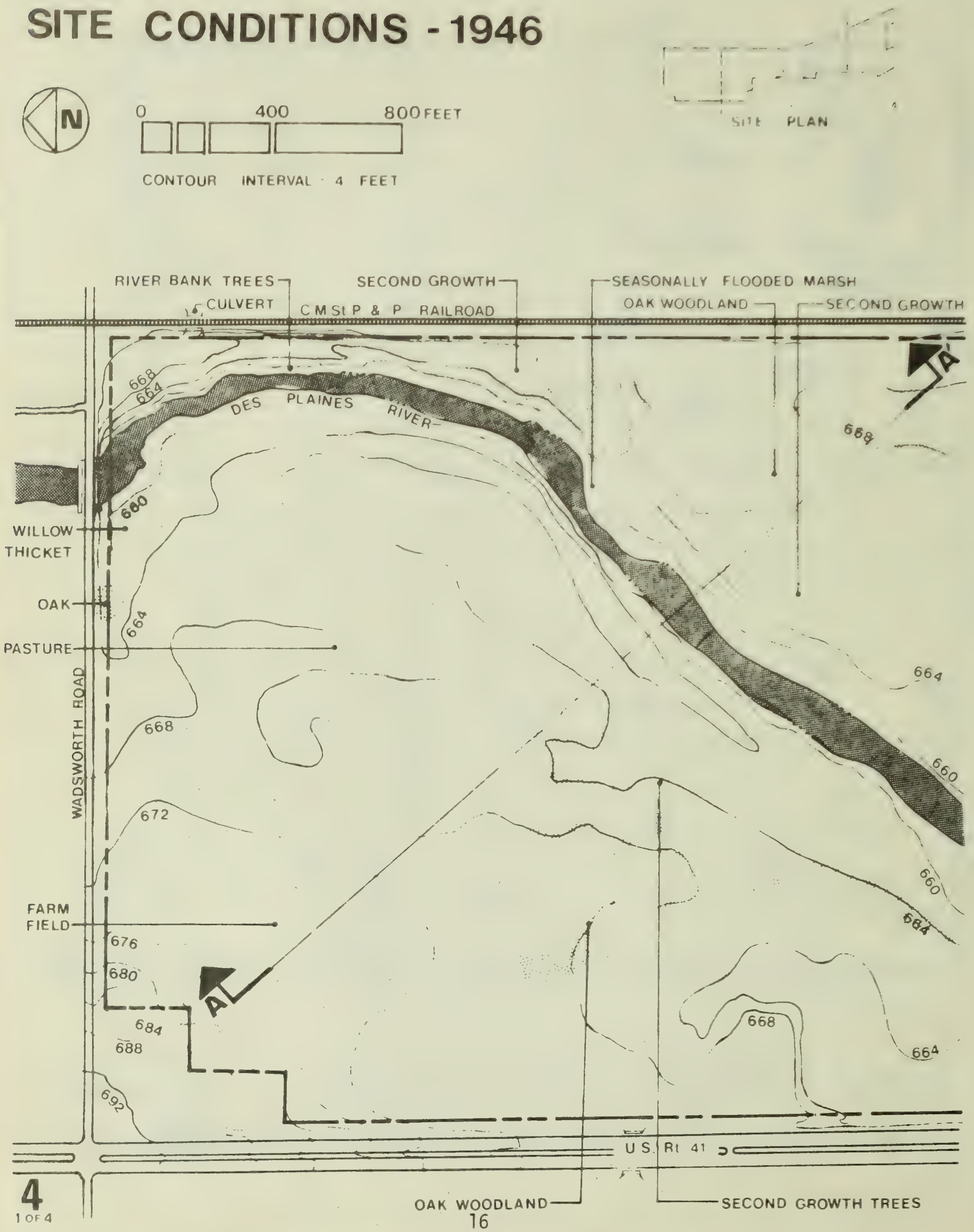


FIGURE 4 :
SITE CONDITIONS - 1946



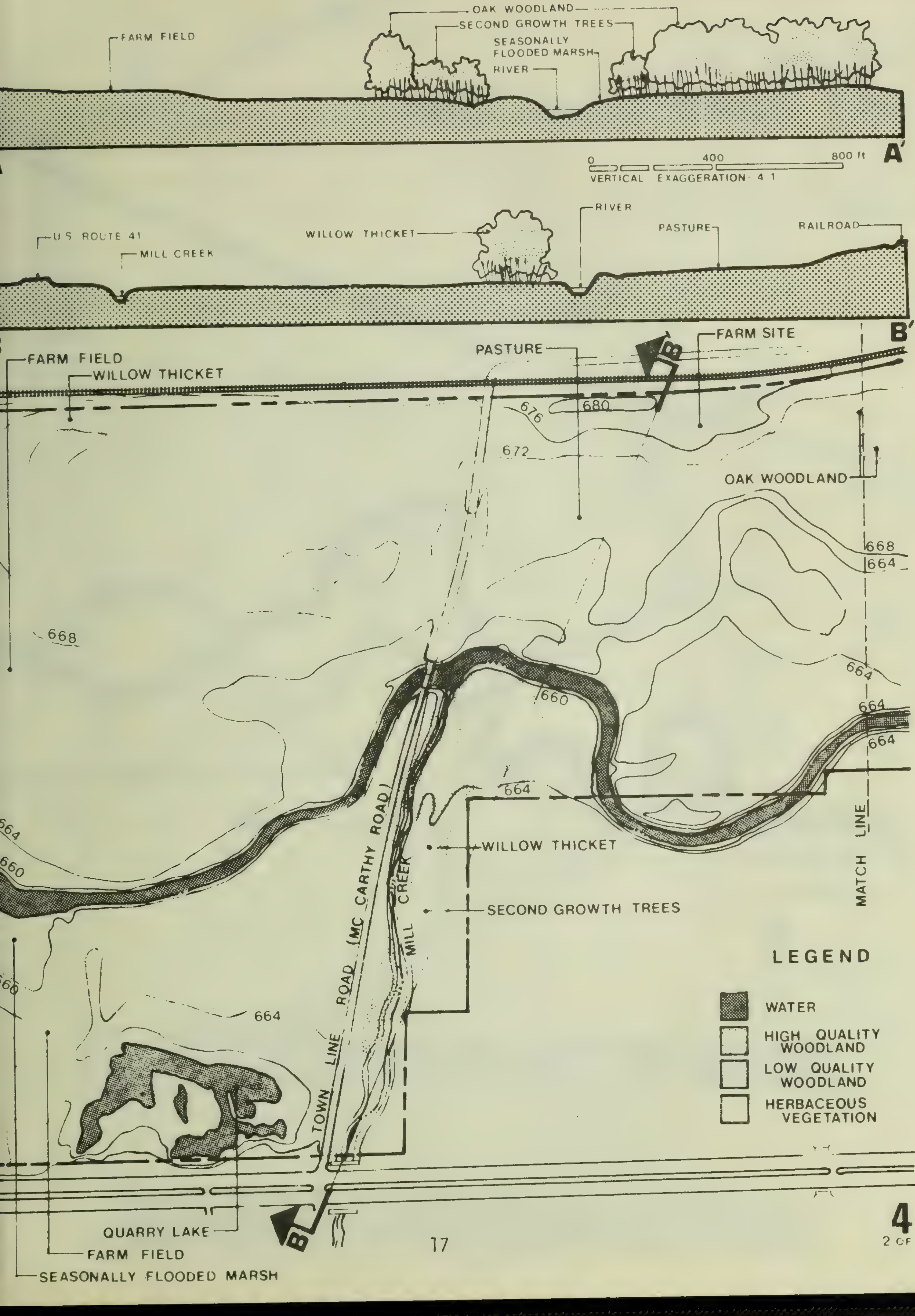
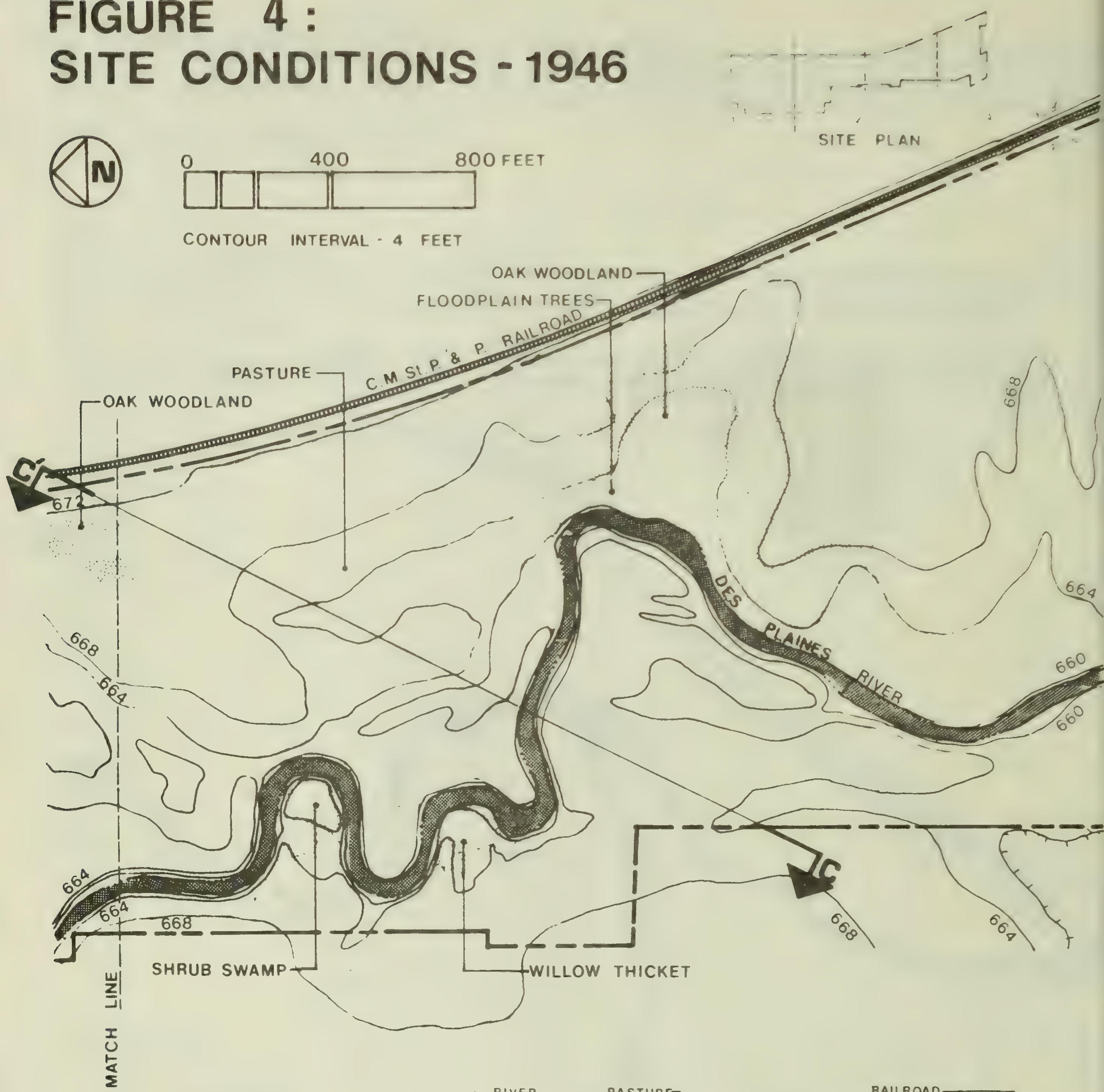
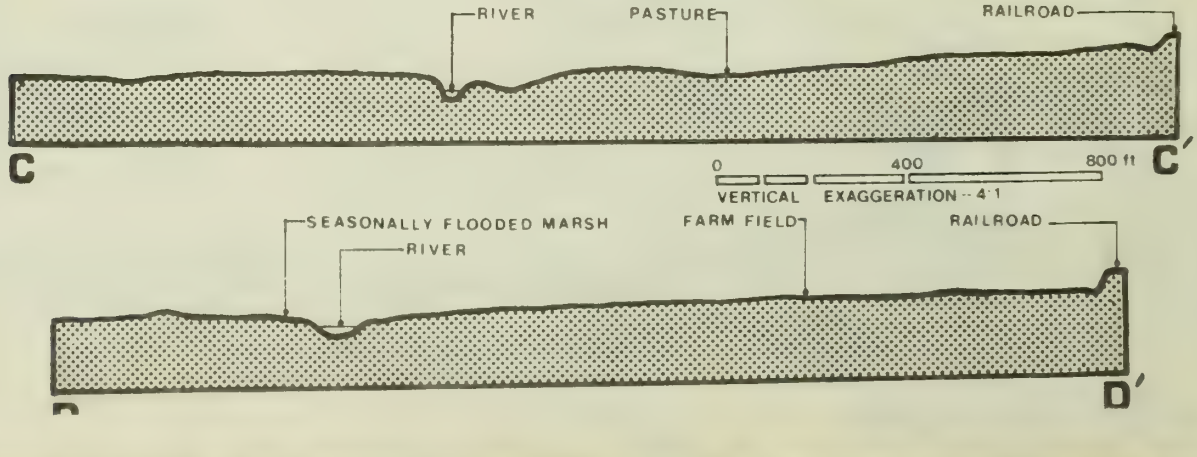

FARM FIELD
OAK WOODLAND
SECOND GROWTH TREES
SEASONALLY FLOODED MARSH
RIVER
A'
0
400
800 ft
VERTICAL EXAGGERATION 4 1
U S ROUTE 41
MILL CREEK
WILLOW THICKET
RIVER
PASTURE
RAILROAD
B'
FARM FIELD
WILLOW THICKET
PASTURE
FARM SITE
B
680
676
672
OAK WOODLAND
668
664
668
664
660
664
664
664
664
660
WILLOW THICKET
SECOND GROWTH TREES
MATCH LINE
TOWN LINE ROAD (MC CARTHY ROAD)
MILL CREEK
664
LEGEND
WATER
HIGH QUALITY WOODLAND
LOW QUALITY WOODLAND
HERBACEOUS VEGETATION
QUARRY LAKE
FARM FIELD
SEASONALLY FLOODED MARSH
B
4
2 OF 4

FIGURE 4 : SITE CONDITIONS - 1946





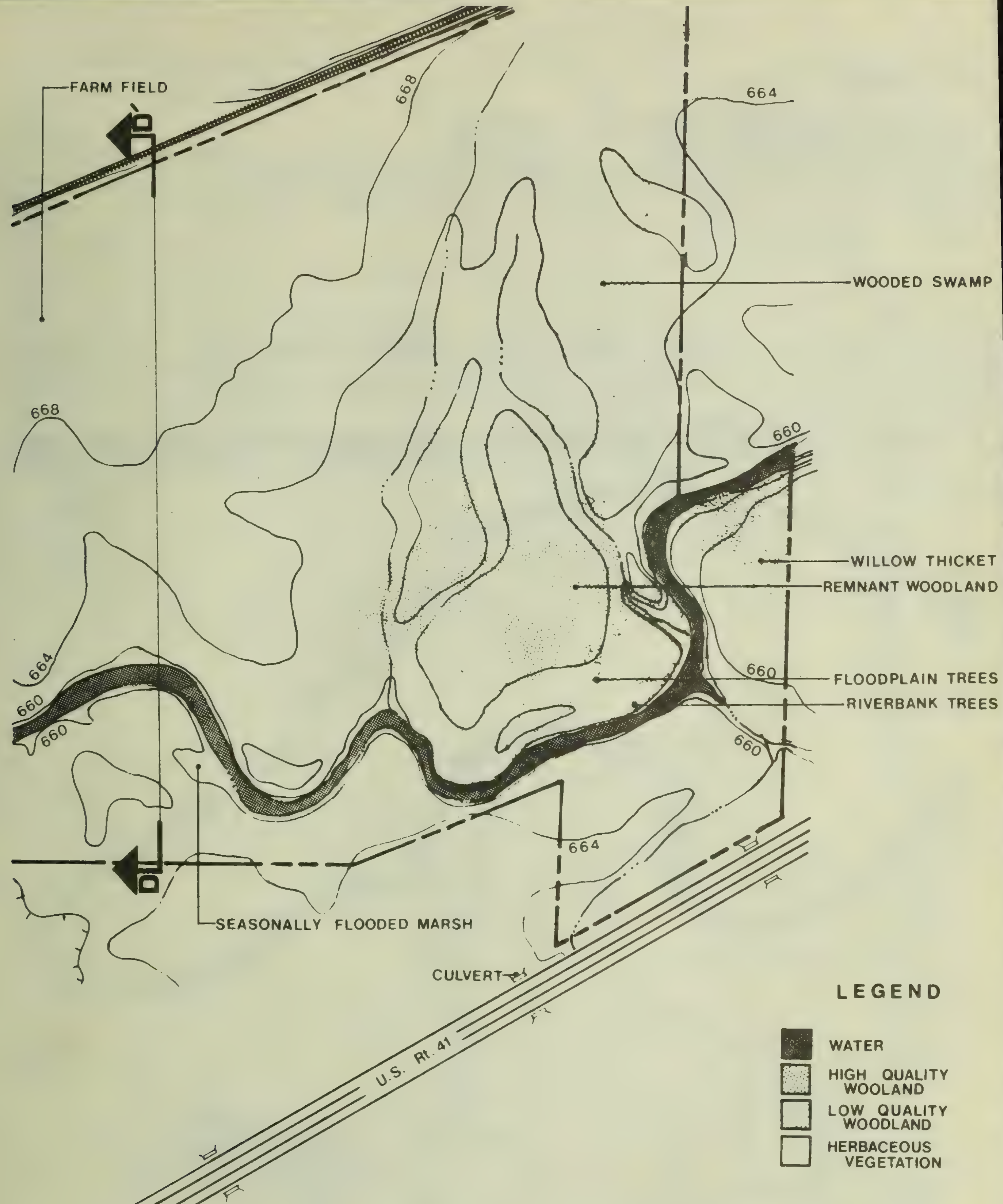
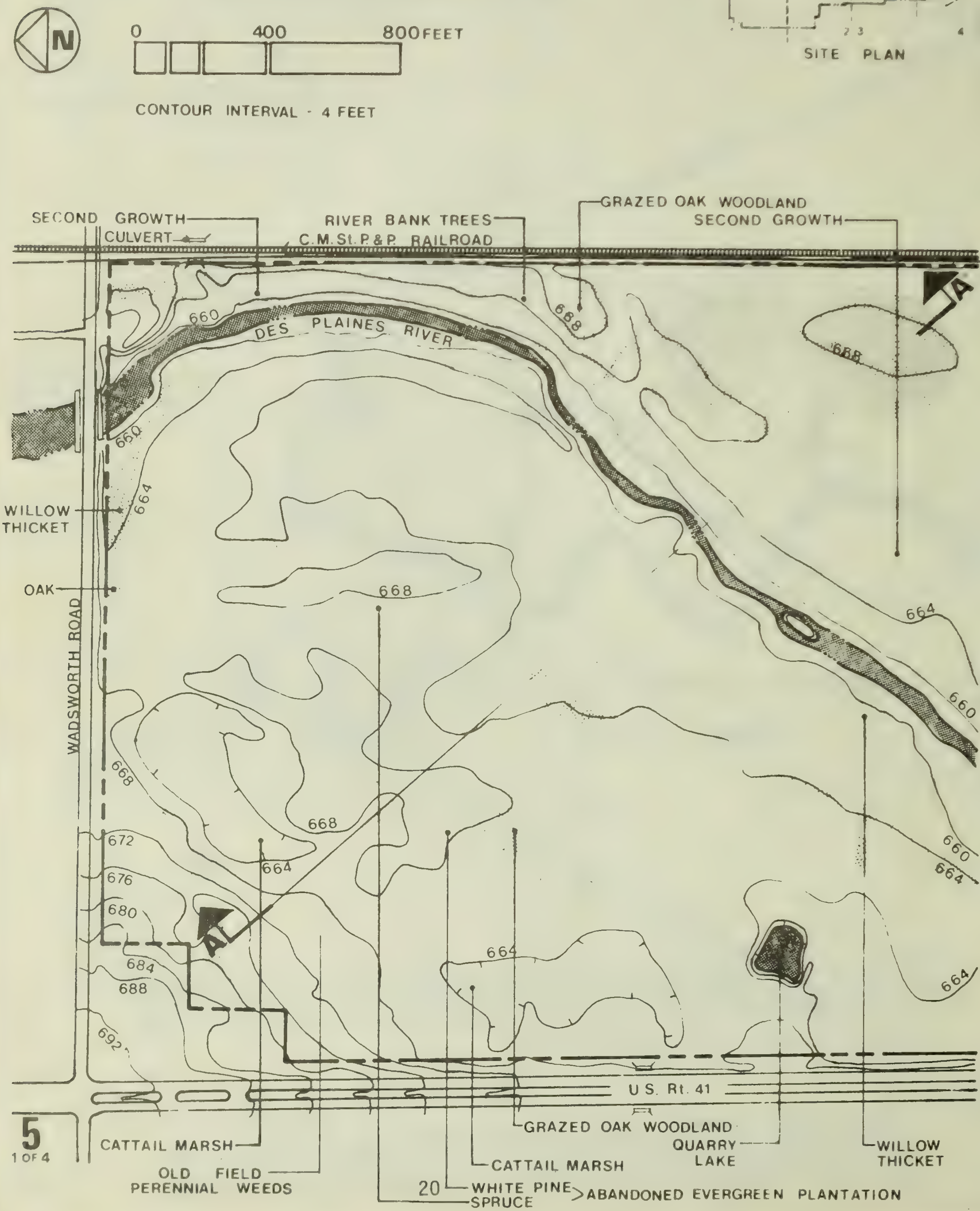
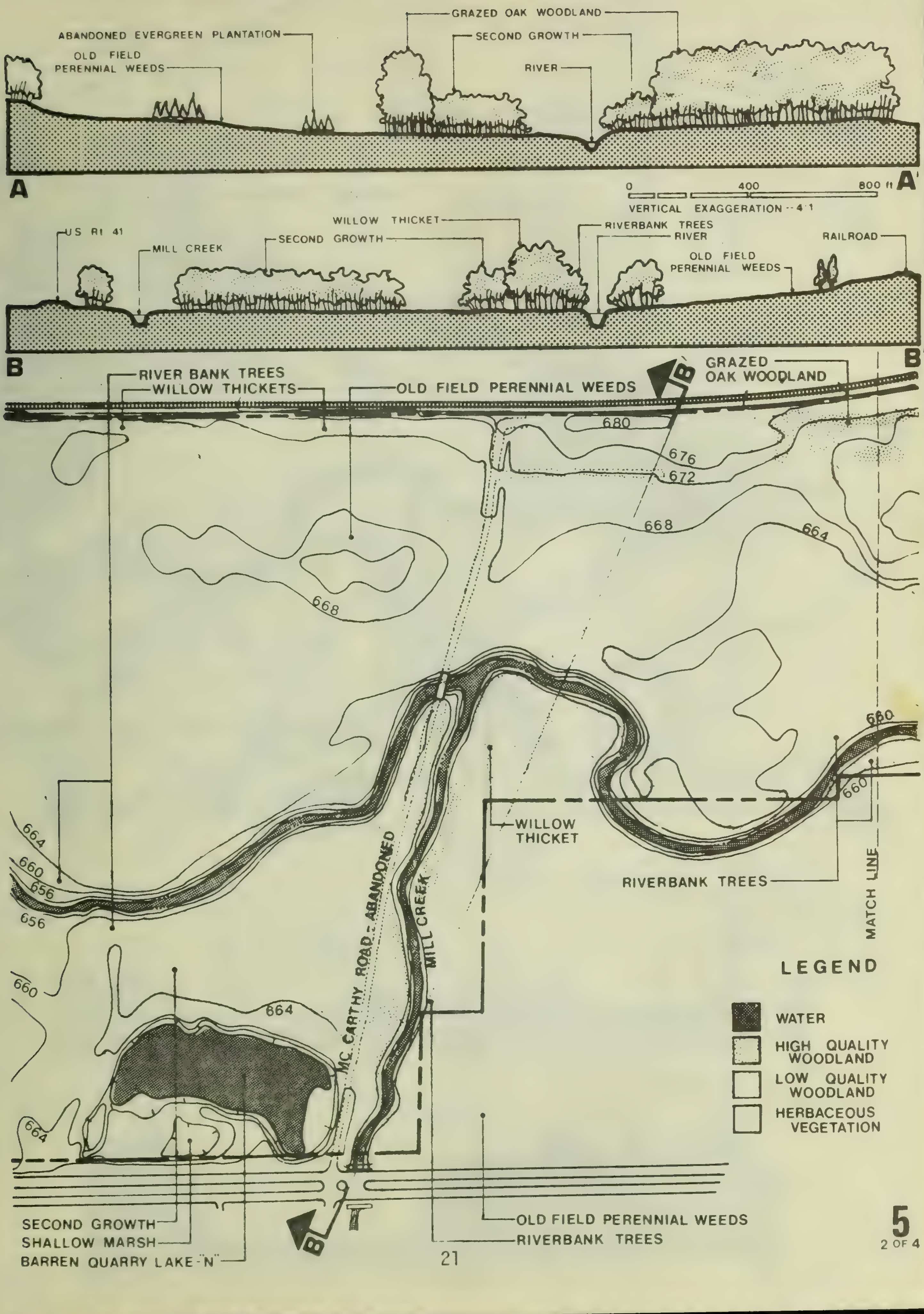

FARM FIELD
668
664
WOODED SWAMP
668
660
664
660
660
WILLOW THICKET
REMNANT WOODLAND
660
FLOODPLAIN TREES
RIVERBANK TREES
660
664
D
D
SEASONALLY FLOODED MARSH
CULVERT
U.S. Rt. 41
LEGEND
WATER
HIGH QUALITY WOOLAND
LOW QUALITY WOODLAND
HERBACEOUS VEGETATION

FIGURE 5: SITE CONDITIONS - 1976




ABANDONED EVERGREEN PLANTATION
OLD FIELD PERENNIAL WEEDS
GRAZED OAK WOODLAND
SECOND GROWTH
RIVER
A
A'
0
400
800 ft
VERTICAL EXAGGERATION - 4:1
US Rt 41
MILL CREEK
SECOND GROWTH
WILLOW THICKET
RIVERBANK TREES
RIVER
OLD FIELD PERENNIAL WEEDS
RAILROAD
B
B'
RIVER BANK TREES
WILLOW THICKETS
OLD FIELD PERENNIAL WEEDS
GRAZED OAK WOODLAND
680
676
672
668
664
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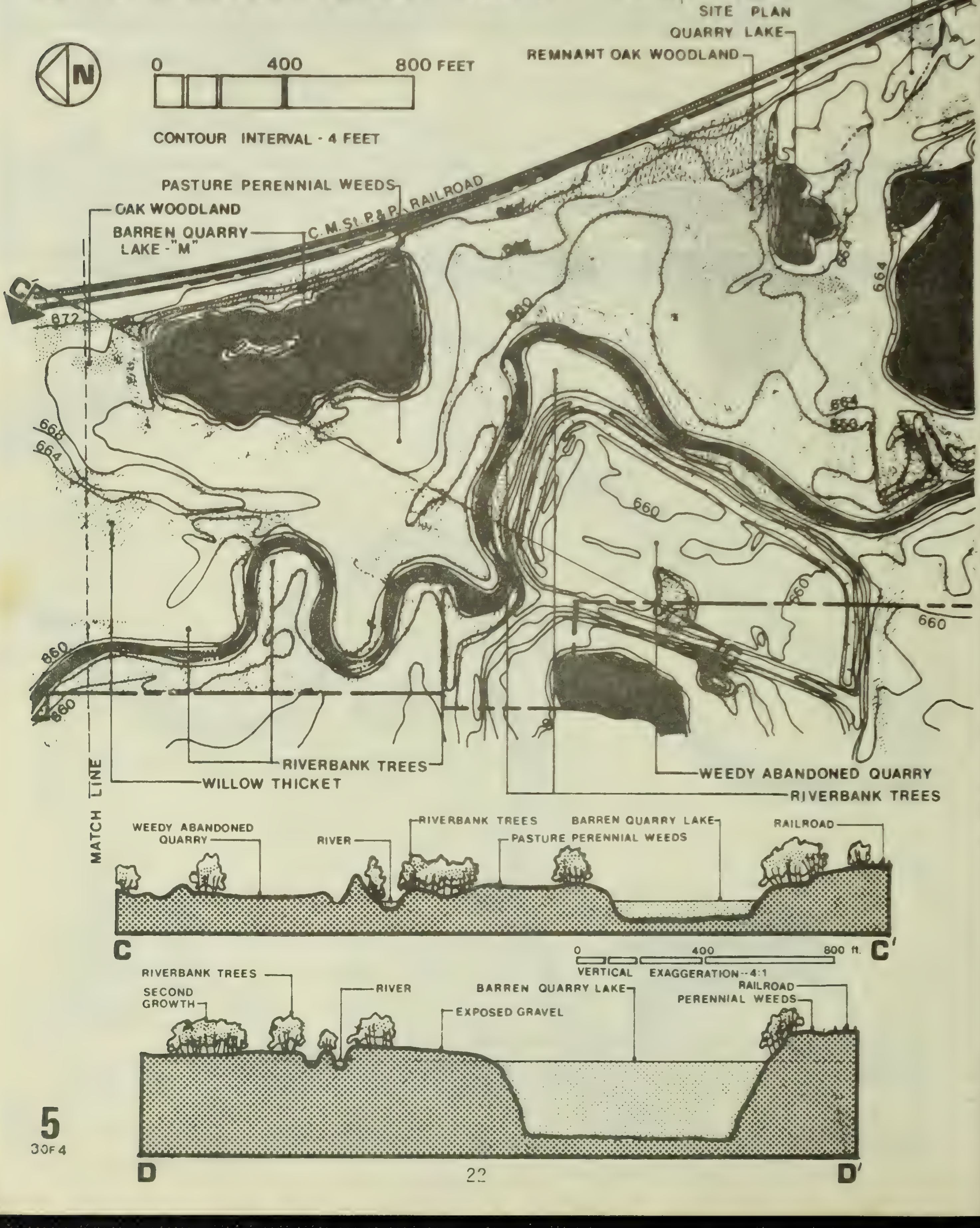
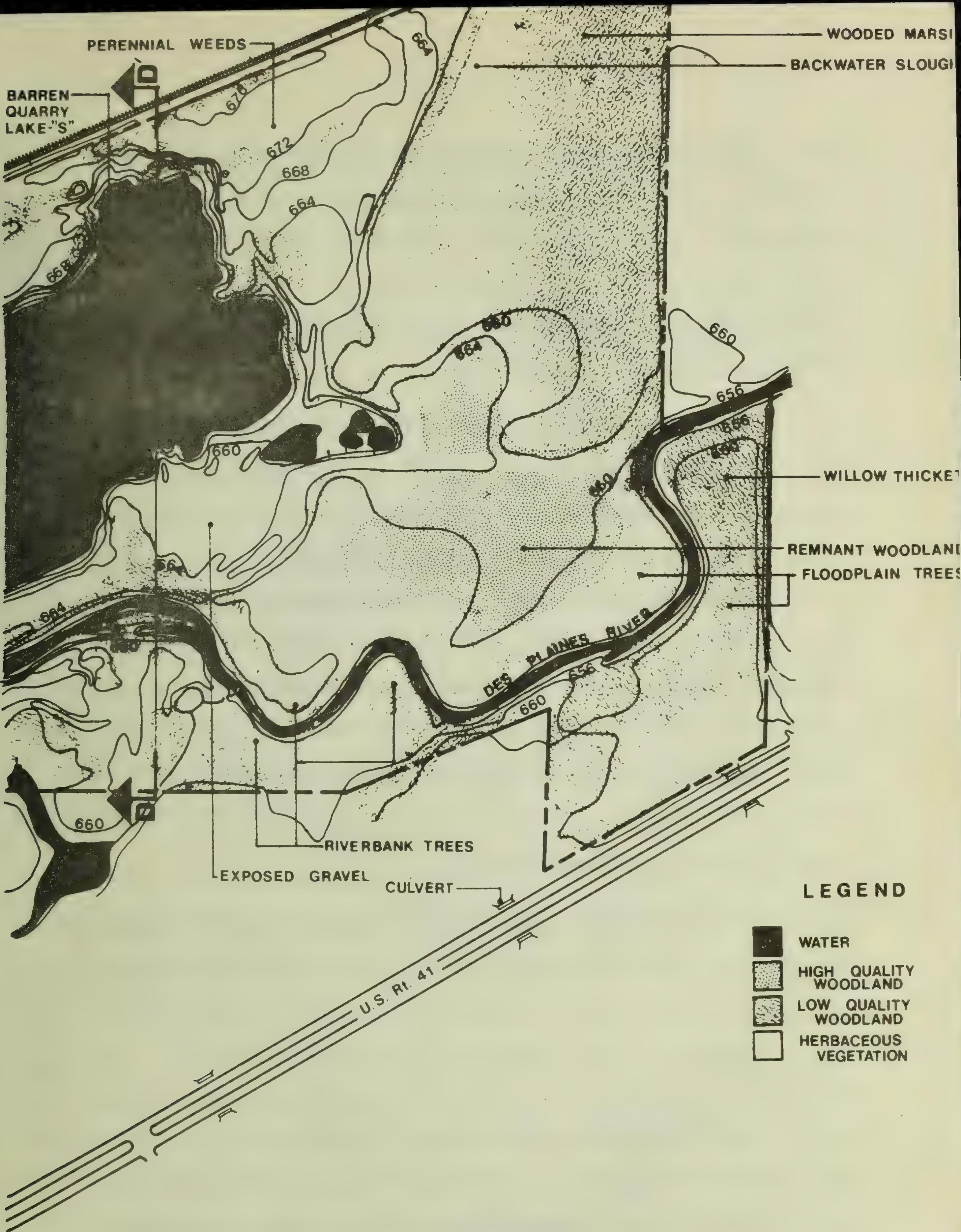
660
664
660
656
656
660
664
664
WILLOW THICKET
RIVERBANK TREES
MATCH LINE
MC CARTHY ROAD - ABANDONED
MILL CREEK
LEGEND
WATER
HIGH QUALITY WOODLAND
LOW QUALITY WOODLAND
HERBACEOUS VEGETATION
SECOND GROWTH
SHALLOW MARSH
BARREN QUARRY LAKE "N"
OLD FIELD PERENNIAL WEEDS
RIVERBANK TREES
5
2 OF 4

FIGURE 5: SITE CONDITIONS - 1976




PERENNIAL WEEDS
BARREN QUARRY LAKE-"S"
WOODED MARSH
BACKWATER SLOUGH
WILLOW THICKET
REMNANT WOODLAND
FLOODPLAIN TREES
DES PLAINES RIVER
RIVERBANK TREES
EXPOSED GRAVEL
CULVERT
U.S. Rt. 41
676
672
668
664
660
656
LEGEND
WATER
HIGH QUALITY WOODLAND
LOW QUALITY WOODLAND
HERBACEOUS VEGETATION

5
4 OF 4

course had been very little changed although the width of the channel appears to be much narrower and deeper than in 1946. In several places, particularly in the southern half of the site, the river was dyked and dredged to protect the gravel workings from floods. By 1976 the floodplain lands had been virtually cut off from the river's inundation and agricultural land use had ceased.

The Lake County Forest Preserve acquired the site in 1973. Since then, some improvements have been made to permit greater public access to the gravel pit lakes and stream. A canoe launch has been constructed in the northeast corner of the site adjacent to Wadsworth Road. Canoeing is restricted to the main river channel since there are no passageways to the gravel pit lakes. The channel is often clogged with debris and the banks are muddy, slippery and steep, making portaging difficult and unpleasant. A trail, in part using the old Town Line Road (McCarthy Road), has been constructed for walking, bicycles, and snowmobiles. Fishing also occurs at the site but catches are generally confined to the rough fish such as bullhead and carp.

The land surface elevation ranges from 680 feet above mean sea level at the northwest corner of the property to 655 feet at the invert (bottom) of the Des Plaines River as it leaves the site. In its natural state, the site was generally flat with only minor variations in elevation. The development of transportation facilities, farming and sand and gravel mining, have substantially modified the topography and in some locations the grade changes are quite abrupt. Embankments for the highway and railroad are four to five feet above the general topography and there are six to seven foot levees around the gravel mines. There are several

gravel pits remaining on the site; three major pits range in size from four acres to eighteen acres and have filled with water.

SOILS

The soils on the site are typical of the floodplains in the county. Areas that have not been disturbed by gravel mining are nearly level with no distinct river terraces and with deep soil formed in silty, clayey, water-deposited alluvium of geologically recent origin. Before channel alteration and disturbance, these soils were frequently flooded and often wet for long periods; the native vegetation was largely prairie marsh grassland. Glacial outwash materials form the substrate for non-alluvial soils on the site. However, these are limited in their extent and many of those soils have been removed during the mining operations of the valuable gravels on which the soils were formed. In a few limited areas, soils have developed on lenses of more clayey glacial materials in the underlying moraine.

Even though the soils of the site have experienced man-made changes ranging from mining to alterations of the channel of the Des Plaines, the remaining and resulting soils are adequate to the proposed wetland restoration.

HYDROLOGY

The Des Plaines River enters the site at the northern boundary through the elevated earth embankment for Wadsworth Road. It then flows through a gentle s-curve as it moves southward passing under a pedestrian and snowmobile bridge on Town Line Road (McCarthy Road) where, on the down-

stream side of the road embankment, it is joined by Mill Creek. It continues south through a number of tight but obtuse meanders and leaves the property 2.8 miles from its point of entry.

As the river moves through the site, it greatly increases its tributary area. Upstream of Wadsworth Road, the watershed encompasses an area of 146 square miles (U.S. Geological Survey, 1977). The inclusion of Mill Creek expands this area by 69 square miles or approximately 50 percent. With the addition of the local drainage area contained in and adjacent to the selected site, the watershed at the southern boundary is 216 square miles.

The natural morphology of the Des Plaines River is due to three major glaciers which covered the watershed (Goldthwait, 1909). As the glaciers advanced, they gouged out the basement complex forming the stream valley. As they receeded, they deposited a mantle of glacial drift. The deposited material is mainly composed of clays and silts with occasional pockets of sand and gravel. Melt water, forming the early Des Plains River, washed out most of the clays and silt in the path of the river leaving the riverbed underlain by coarse sand and gravel. These are the predominant materials found in the riverbed today, aside from the materials which have been deposited as a result of agricultural development and urbanization.

Because of the moderate slope of the drift mantle and outwash plain, the Des Plaines River possesses only sufficient energy to move from side to side, trimming bends and spurs; consequently, the drift mantle remains uncut and the stream gradient relatively flat. The invert of the river channel

falls only 2.9 feet (Des Plaines River Steering Committee, 1975) from Wadsworth Road to the southern end of the site while it traverses 14,600 feet. This gives a slope of 0.000199 feet/foot which is approximately one half of the average slope (0.000284 feet/foot) for the entire Des Plaines River. The very gentle slope of the river limits its velocity to between less than one foot and three feet per second. Only during rare flood events when flows are extremely high does the stream possess sufficient energy to reshape its banks and floodplain. Consequently, changes made to the river remain in place for a long time. Its course is easy to control through channelization and through the stabilization of its banks by vegetation. Evidence of this can be readily seen at the site.

Once moved or modified by a levee or by dredging for gravel in the bottom of the channel, the river tends to stay in its new position. This tends to concentrate and slightly increase the energy of the river along a very narrow ribbon. Where the stream is restricted by man-made embankments or heavy vegetation, velocity and energy are increased sufficiently to transport more and larger material. Throughout the project site, the Des Plaines River is of sufficient size that long stretches have not been channelized or at least not entirely straightened. In Wisconsin, conditions are considerably different. There, almost every reach of the river has been modified for agricultural purposes and long stretches have been straightened. This has increased the energy of the river causing it to carry a greater suspended load of clay and organic materials into Illinois.

Of the tributary area above the proposed site, only 23 square miles are in Illinois while 123 square miles are in Wisconsin. At the southern

end of the project site, 89 square miles are within Illinois, increasing the percentage in Illinois from 16 to 42. With the preponderance of the area in Wisconsin, it is not surprising that the majority of the water comes from there. As measured at Wadsworth Road, 84 percent of the water comes across the state line as either surface runoff or intercepted groundwater. Less than one percent of the water entering Illinois originates as waste water effluent. There are five treatment plants in Wisconsin (Southeastern Wisconsin Regional Planning Commission, 1974) which discharge to the Des Plaines or one of its tributaries. The combined magnitude of the effluent from these plants is approximately one cubic foot per second. Above Wadsworth Road in Illinois there is only one minor treatment plant which discharges less than one cubic foot per second. There are, however, four treatment plants discharging approximately three cubic feet per second to Mill Creek but, given the greater yield of Mill Creek and the added tributary area, the waste water effluent component of streamflow remains at less than one percent at the southern boundary of the site.

Approximately one third of the watershed's mean annual precipitation ends up as streamflow. This means that, of the thirty-three inches of precipitation, ten inches move over the surface or pass through the soil and shallow groundwater ultimately reaching the stream channel. The average yield of the Des Plaines River at Russell Road, at the boundary between Illinois and Wisconsin, is 10.7 inches (U.S. Geological Survey, 1977) based on a thirteen year period starting in 1967. Given this yield and using the larger tributary area at Wadsworth Road, the mean annual discharge of the Des Plaines River entering the proposed site is 115 cubic

feet per second. A good deal more water is available in the lower reaches of the project site. In fact, due to Mill Creek, the flow is increased by 59 percent. At the southern boundary, the mean annual flow is 183 cubic feet per second.

During several of the past 13 years of record (1967 to present) zero flow has been recorded at Russell Road (U.S. Geological Survey, 1977). Given the very low quantity of waste water effluent, it is likely that zero flows could and have occurred throughout the project site even given the added inflow from Mill Creek. In fact, zero flows have been recorded, in recent years, on the Des Plaines River near Gurnee which is downstream of the site.

The United States Geological Survey (USGS) and the Soil Conservation Service (SCS) have estimated elevations for numerous extreme hydrologic events. The USGS estimates that the mean annual flood at Wadsworth Road reaches an elevation of 665.7 feet and that of the 50 year flood reaches 666.8 feet (Noehre, 1964). Two historic flood events, measured at Wadsworth Road by the USGS, exceeded the mean annual flood elevation and one exceeded the 50 year elevation. The flood of March-April 1960 reached an elevation at Wadsworth Road of 667 feet, while the flood of March, 1962 reached the elevation of 666 feet. The SCS estimates that the 100 year flood at Wadsworth Road would reach the elevation of 668.6 feet with a maximum discharge of 3,502 cubic feet per second (Des Plaines River Steering Committee, 1975), almost 30 times greater than the mean annual flow. They also have determined the stage and discharge of the 100 year flood for the southern terminus of the project site: 667.6 feet and 5,782 cubic feet per second.

There is little known information about the shallow groundwater on the project site. Some well drilling has taken place; however, the bore holes were extended to the deep aquifers without consideration of shallow groundwater. There is no reported hydrologic connection between the deep aquifers and the project site. The only information available can be found at the State Water Survey in Warrenville, Illinois. The Lake County Forest Preserve District has installed several hand pumps in the shallow aquifer and sustained yields are reported.

The physical characteristics of the three main gravel pit lakes are shown in Table 1. Water levels fluctuate with groundwater levels and with flood stages of the Des Plaines River; otherwise these pits have no watershed.

Table 1: Physical Characteristics of the Principal Gravel Pit Lakes at the Site

	Northern Pit	Middle Pit	Southern Pit
Acres	4.7	7.6	18.5
Acre feet	40.0	51.7	410.7
Average depth (ft)	8.5	6.8	22.2
Maximum depth (ft)	14.5	10.0	36.0
Shoreline length(ft)	2380.0	2380.0	4880.0
Secchi disc (ft)	8.7	5.0	7.7
pH	8.2	8.2	8.2
Temperature (°F)	68.0	68.0	68.0

Data provided by the Lake County Forest Preserve District; taken June, 1975 by the Illinois Department of Conservation.

WATER QUALITY

A testimony to the potential quality of the river can be found in the statement made in the 1860s: "The Des Plaines River abounds in deep and shady pools, from which large quantities of excellent fish, some of them of great size, are annually taken. The pools are also extensively used for bathing and swimming." (Libertyville, 1946). Of course, at that time the watershed was covered with prairie and woods -- the river providing for and benefiting from the plant community. The prairie and forest held the silty clay soil in place preventing it from reaching the stream. The slowly moving river through its wide, shallow channel, unconfined by levees or road embankments, possessed little energy for transporting soil particles downstream. The fact that people were bathing and swimming in the Des Plaines River and that excellent fish were taken are testimonies to the stream's clarity and chemical quality. Today, few would dream of bathing in the Des Plaines River and the quality of fish is poor.

Setting aside for the moment the more detailed chemical characterization of the Des Plaines River, a more important factor needs to be considered: the visual appearance of the river. This is perhaps the first aspect of the river that is noted by professional and lay persons alike. Floating materials (oil or trash), color, and turbidity are the principal indicators of poor visual quality. High turbidity is the characteristic that most limits the appeal of the Des Plaines River today. For most of the year, the turbidity of the river is such that light cannot penetrate more than two or three inches. This means that the bottom of the river is rarely visible even in the most shallow reaches. The immediate cause

of the high turbidity is the suspended material carried by the river, a condition which persists throughout the year abating only during the low flow period of late fall. Approximately 80 percent of the suspended material is mineral matter and the other 20 percent organic (Northeastern Illinois Planning Commission, undated A). The origin of the organic matter is either plant detritis washed from the land surface, decayed aquatic plants or living algae. On the other hand, the mineral matter originates on the land surface and is washed into the drainage system or, to a much lesser degree, is eroded from the stream banks during high flow periods. Because of the high suspended loads, the Des Plaines River is unattractive. Receeding high waters deposit a thin layer of mud which makes the stream banks uninhabitable except by the most tolerant plants. This is certainly true for the reach of river within the proposed site.

Since the Des Plaines River was apparently once a clear and attractive stream, the chain of events that brought about the changes probably started with the removal of native vegetation leaving the soil exposed to erosion. This allowed fine clay and silt particles to reach the stream. It must be assumed that even when prairies and forests dominated the watershed some mineral material was being washed to the stream and it apparently settled out or was trapped by aquatic plants. There are several reasons why this no longer happens. Many of the original wetland areas have been drained and in the place of wetlands, narrow, hydraulically efficient drainage channels were constructed. The banks are steep and unvegetated, confining the water to a very small area, exposing the banks to erosion, and increasing the energy with which the organic, clay, and silt particles are suspended and transported. Con-

sequently, as the river enters Illinois, it is highly turbid and it remains so throughout its entire length.

In Illinois, for the most part, the Des Plaines River is of sufficient width that complete channelization was not practical. However, many portions of the river have been modified, the channel straightened or confined, to prevent the river from flooding agricultural fields, gravel pits or other areas of economic value. As with the agricultural drains in Wisconsin, these channel modifications have tended to increase the river's energy causing more suspended material to be transported, thereby affecting the river water's visual and chemical qualities.

Given the restricted channel and the high turbidity which prevent light penetrating the water, sight feeding fish such as pike and other high quality fish are unable to compete with bottom feeders such as carp. Carp stir up the bottom sediments helping to maintain higher suspended loads. This is particularly evident at the proposed site during the spawning season.

Algal blooms also contribute to the turbidity and unsightliness of the river. These are the large populations of single cell, floating plants which give the river a green hue. The plant cells block the penetration of light, inhibiting the growth of more desirable attached plants. When they die their cell tissue contributes to the organic pollutant load of the river. Algal blooms are most in evidence during the warmer months of the year.

The presence of carp, the now common occurrence of algal blooms, and high spring flows all keep the river in a high state of turbidity. Lacking

contact with aquatic plants and confined to a fairly narrow stream channel, the river no longer possesses the ability to adequately rid itself of these mineral and organic particles. In turn, these materials preclude the growth of aquatic plants which might filter out suspended load and help clarify the stream.

Plant nutrients, principally nitrogen and phosphorous, were certainly present in the predevelopment river. Their concentration varied through the year depending on the growth cycle of the plants both in the watershed and adjacent to the stream. Today, the nutrient load is much greater due to the use of fertilizers, the greater quantities of material washed into the stream from urban and agricultural areas, and the direct discharge of nutrients from municipal treatment plants. Equally important is the lack of emergent and attached aquatic life which might extract the higher nutrients from the river and limit their availability to such unsightly plants as blue-green algae. As it is, nutrient concentrations still vary over the annual cycle but this, more often than not, is caused by luxuriant algal growths.

Of the nutrients in the river passing through the proposed site, approximately 50 percent of the nitrates, 21 percent of the ammonia, and some 32 percent of the phosphorous originate in Wisconsin. Similarly, the treatment plants on Mill Creek provide substantial quantities of ammonia, nitrates and phosphorous. They account for 29 percent of the ammonia, 2 percent of the nitrates and 16 percent of the phosphorous. The nutrient loads in tons per year are given in Table 2. The low concentrations given in Table 2 were generally recorded in summer. The high values were recorded in the winter.

Table 2: Typical Concentrations and Loads of Nutrients in the Des Plaines River at Wadsworth Road

Constituent	Concentration[1] (milligrams/liter) Low	High	Load[2] (tons/year)
Ammonia	0.00	1.60	150.0
Nitrate	0.10	5.00	231.0
Phosphorous (dissolved)	0.03	0.34	34.7

1. Northeastern Illinois Planning Commission, undated A.
2. Northeastern Illinois Planning Commission, undated B.

One of the principal chemical characteristics of any stream is dissolved oxygen, on which aquatic life is dependent. The more desirable fish species require quantities above six milligrams per liter on a consistent basis. Less desirable organisms such as carp, can and do survive at much lower concentrations. Consequently, the lack or abundance of dissolved oxygen directly affects the aquatic life found in a stream. The Des Plaines River through the proposed site is characterized by periods of low dissolved oxygen. During the summer dissolved oxygen can dip below one milligram per liter and approximately one third of the time the river is below six milligrams per liter (Northeastern Illinois Planning Commission, undated A).

There are four factors which contribute to the low dissolved oxygen: high organic loads, plant respiration, sediment oxygen demand and low reaeration. The organic loads come from urban and agricultural runoff and wastewater treatment plants. Over half of the organic load originates in Wisconsin. The remainder can be traced to runoff from Illinois (with only four percent coming from wastewater treatment plants). Part of the organic load is oxidized within the stream, or water column, depleting the available

dissolved oxygen in the stream. The other part settles to the bottom of the stream to be oxidized at some later date, draining the oxygen resources via sediment oxygen demand. During the daylight hours algae convert water, nutrients and carbon dioxide, with the aid of certain other chemicals and light, into protoplasm, releasing oxygen as a by-product. During the hours of darkness, algae convert protoplasm back into energy in order to sustain themselves and, in the process, consume oxygen. This later process is known as respiration and it depletes the available oxygen supply. Further, as the algal cell dies it contributes to the organic load of the stream requiring further oxygen for the decay of the cell.

The stream also replenishes its oxygen resources by reaeration, the transfer of oxygen from the atmosphere to the water. Reaeration is a function of water temperature, the quantity of oxygen already in the water, stream depth, and the degree of disturbance between the air/water boundary layer. Holding all other factors constant, the deeper the stream and the smaller the surface area, the lower the reaeration.

As a prairie stream, the oxygen balance of the Des Plaines was maintained at a fairly high level, averaging perhaps eight to ten milligrams per liter, as evidenced by the high diversity of fish that existed then. Under the predevelopment condition, reaeration was sufficient to maintain dissolved oxygen at desirable levels while the stream satisfied the dissolved oxygen demand. This balance was upset when the stream was deepened and its surface area reduced, because in so doing reaeration was reduced. Further, greater organic loads were discharged to the

stream because of agricultural and urban development. In its present physical state, the Des Plaines River through the proposed site cannot sustain high dissolved oxygen levels due to its limited ability to capture oxygen from the atmosphere and rid itself of the increased organic load.

By almost every measure, the Des Plaines River in the vicinity of and passing through the project site is a polluted stream (Hey and Kirschener, 1981). Visually, it is unattractive. It is turbid and its banks are laden with silt. There are few aquatic plants along its banks or emerging from its streambed. Periodically, luxuriant algal growths occur. Dissolved oxygen is generally too low to support a diverse fish life and as a result rough fish such as carp abound. In turn, these fish aggravate the poor quality of the stream by continually stirring up deposited materials. Undoubtedly there are other measures which would further indicate the extent of contamination and the low quality of the stream, but little or no information exists on such contaminants as heavy metals or trace organics which indicate the presence of herbidides and pesticides. Nevertheless, given the high state of urban and agricultural development in the watershed, their presence is presumed.

VEGETATION

The earliest vegetation record is shown in Figure 4; in 1946, the influence of farming was strong and the woodlands restricted. By 1976 (Figure 5) the fields had been abandoned and much second growth woodland filled the site; this is still the case today. The southernmost section of the site includes a remnant woodland of reasonably high natural quality. The northern sector includes areas of grazed-out oak woodlands and an

abandoned evergreen plantation. Elsewhere old field plant communities dominate with second-growth woodlands emerging closer to the river banks. Because the Des Plaines River has been highly modified, the full development of shoals, bars, backwater sloughs, and marshes with their associated vegetation has been preempted. The gravel pit lakes are essentially devoid of vascular vegetation, though their waters are quite clear. In very few areas, where their shores grade moderately from the surrounding uplands, cattails and a few other less noticeable plants thrive only tentatively in a narrow, restricted zone.

Surveys of the vascular plants of the project site were conducted on April 18th and May 29th of 1981. Additional floristic records were taken from data provided by Laurie (1980a). The Latin names and most of the common names used throughout this description and in the appended tables follow those employed by Swink and Wilhelm (1979).

The river waters are all but devoid of aquatic vegetation, except for an area in the northern sector where there is a population of white water lily. The ancilliary paludal communities usually associated with healthy, slow-moving, meandering prairie streams are poorly developed. The high banks are floristically depauperate, consisting largely of the ubiquitous woody plants and herbs which are characteristic of such areas. A list of the plants which typify these banks is provided in Table 3 (see Appendix). Each plant listed is preceded by its autecological rating coefficient. The mean rating coefficient for the plants listed in Table 3 is 0.65. This coeffieient indicates that the banks along the Des Plaines River support low quality vegetation. Land with fundamental

natural quality has mean coefficients of 3.5 to 4.0 or even higher.

The remnant woodland in the southernmost sector of the site ranges from mesophytic to wet in character. While disturbed in various ways, the western half of this woodland nevertheless reflects native conditions to a rather profound degree. The plants known from this woodland are listed in Table 4 (see Appendix). Once again each plant listed is preceded by an autecological rating coefficient. The mean rating coefficient is 3.70, which demonstrates the good, natural quality of these woods. (Compare, for example, this rating with that given for the river bank vegetation in Table 3.)

The remainder of the site includes areas which are either in some form of second growth after having been denuded of vegetation during some time in the recent past, or are the remnants of once prairie-like savannas. These areas range in character from low grade wetland to old field, and from gravelly, ruderal waste ground to dog-hair thickets and over-grazed woods. The northern sector even includes a few areas where spruces and white pines have been planted. There is, consequently, little meaning in discriminating among "plant communities" since the communities are all fundamentally artificial and intergrading in character. The plants known from these portions of the site are listed together in Table 5 (see Appendix). Their overall mean rating coefficient is 1.86, suggesting strongly the mix of Old World and weedy native plants which dominates the revegetated portions of the site.

ANIMALS

For obvious reasons, the accumulation of animal inventory data is prob-

lematical and meaningful surveys are enormously difficult to accomodate during a few short months. Data for terrestrial invertebrates for the project site are meager or absent altogether. Virtually all of the data for the project site were made available by the staff naturalists of the Lake County Forest Preserve District. These data include information on fish, benthos, zooplankton, phytoplankton, amphibians, reptiles, mammals and birds. Much of these data are compiled in the Des Plaines River Aquatic Study (1978) based on surveys conducted by the Illinois Department of Conservation and the Lake County Forest Preserve District during 1975 and 1976.

Fish

Data on fish populations in the study area were, for the most part, gathered in the mid-1970s by the Illinois Department of Conservation during an impoundment survey. The Latin and common names used in Tables 6 and 7 (see Appendix) for fishes are those employed by Smith (1965).

Electroshocking techniques were employed during the impoundment survey, so all of the standard limitations of such methods have influenced the data. Age class data are unavailable, so it is not clear, for example, whether or not there is reproduction occuring among the fishes in the gravel pit lakes. The depth and clarity (see Table 2, page 35) of the borrow pit waters have made representative data particularly difficult to acquire.

Nevertheless existing data (see Table 6) seem to suggest that the borrow pits are generally poor in species and particularly poor in forage

fishes. But the data really do not provide enough information to allow meaningful speculation on the ecology of the fish in these pits. Clear, deep, vegetation-free borrow pits generally are not ideal conditions for the propagation of a diverse, well-balanced lacustrine ecosystem.

The northernmost pit, when electroshocked for 20 minutes, yielded 36 percent carp and 28 percent bluegill; black crappie and largemouth bass each made up 10 percent of the yield. There were only one or a few individuals of each of the other recorded species. The middle pit yielded 36 percent bluegill and 38 percent carp. Two individuals (8 percent) were yellow bass, each about 7 inches long. This suggests that someone in the past has attempted to stock at least this pit, if not the other two, since stocking is the usual local source of yellow bass. This pit is reported to be used by ice fishermen during the winter.

The southernmost pit, which is far deeper (up to 36 feet) than either of the other two, yielded 44 percent bluegill and 30 percent largemouth bass, the largest of which was under 9 inches. An 18 inch northern pike was also recorded. Local fishermen tell of larger fish from this pit,and their predilection for fishing it suggests that their reports are more than wishful thinking. Electroshocking in a clear deep lake is not very efficient at recovering large fish, because these fish will most probably be in the greater depths, away from the shock field and from bright light. Indeed, even many of the smaller fish in such pits are apt to be spooked to deeper water by the boat and other apparati related to electroshocking.

The Des Plaines River itself, while generally richer than the gravel

pits in fish species, nevertheless received a "poor" rating by Smith (1971) as far as fish populations were concerned. This rating was based upon the river system's condition relative to 32 other major river systems in the state. Smith stated further that there were 63 species of fish known from the river system as a whole. He took the system to include the DuPage River, Salt Creek, and other direct tributaries and canals of the upper Illinos River. He explained his analysis by noting that "problems are domestic and industrial pollution and extensive modification of streams and habitats."

The Des Plaines River Aquatic Study's (1978) fish survey recorded 24 species of fish (see Table 7) from the Des Plaines River itself. An additional seven species were recorded from Mill Creek only, and not from the river proper. The significance of the Mill Creek data has to do with the possibility that, if habitat conditions improved in the river, populations of at least these seven species might find their way into the river's main stream.

The Des Plaines River Aquatic Study (1978) summarized its fish survey with the following points:

1. "many desirable game species were present, including: northern pike, black crappie, bluegill, green sunfish, pumpkinseed, rock bass, largemouth bass, smallmouth bass, and catfish."
2. "suckers, bullheads and particularly carp, dominated the total number of fish and biomass. Carp were noted as being disruptive of the river bottom, thus increasing turbidity."
3. "the young of all reported species of fish were found indicating

that populations were reproducing."

4. "field observations showed that the fish populations were generally in good physical condition. There were few parasites and the fish did not appear to be stunted, although no physical condition studies were conducted...Species such as small mouth bass and darters, indicate that clean water species can survive in the Des Plaines River."

The same study also pointed out that "...Fishing pressure on the river was light, (except for carp fishermen, who were quite successful). This may be explained by several existing conditions:

1. only minimum access is available to fishermen.
2. the river is shallow and narrow, less than three feet.
3. The apparent lack of deep pools in the river, a favored refuge for game species, eliminates 'good fishing spots' and reduces the chance of catching preferred fish."

Benthos

The benthos include all the animals which live in or on the substrate of aquatic life systems. The kinds of benthos present in abundance are frequently used to indicate the degree to which rivers are considered polluted. Sludgeworms, for example, can tolerate high concentrations of organic material where fish cannot survive. They are indicators of profound pollution. Freshwater mussels and mayflies, on the other hand, are examples of animals which are usually quite intolerant of decomposable organic wastes. Usually their habitats are conducive to healthy and diverse fish populations, and the waters usually are assessed to be clean.

None of these species (sludgeworms, freshwater mussels, or mayflies) are found at the project site.

Table 8 (see Appendix) lists the benthic organisms known from the project site. The Des Plaines River Aquatic Study (1978) summarized its conclusions concerning the benthos of the local portions of the river as follows: "worms (Oligochaetes) and midges (Chironomidas) dominated the total number of organisms and biomass during the year of the study. These organisms are often not available as food for fish. Greatest productivity occurred in late summer and late fall, during the period when the river had a low current velocity and low total discharge,... (and) where nutrient concentrations were highest, and at slow, wide sections of the river. Gravel, silt, and detritus were the most productive substrate associations throughout the year. Silt and detritus were the most productive at times of high flow...There was a general absence of clean water species such as mayflies and stone flies, even at riffle areas in the Lake County portion of the Des Plaines River. Based on diversity indexes and the relative densities of indicated species, water quality in the Des Plaines River was classified as moderately polluted."

Phytoplankton

The phytoplankton (suspended algae) can be considered the basic component of a river ecosystem, although patterns of distribution and density are often difficult to discern. Blum (1956) points out that: "Many factors affect the distribution, density, and species compositon of algae in natural waters. These include the physical characterisitics of the water, time of storage, temperature and chemical composition, reproduction and elimination, floods nutrients, human activities, trace elements, and seasonal cycles.

The phytoplankton of a river are composed of wayfaring species from bottomland sloughs and feeder streams, and indigenous euplanktonic species. They also are composed of algal species that are generally found on top of the substrate, but have been suspended in the water by some local bottom disturbance. These algae are at the whim of the fluid within which they live. Thus, as the riverine conditions vary, so do the species composition, distribution, and density of phytoplanktonic populations.

Phytoplanktonic data for the project site are virtually unavailable. The Des Plaines River Aquatic Study (1978) recorded a list of about 40 algal genera which indicated that, at the McCarthy Road sampling station (at Town Line Road), several algal genera were recorded only three out of 11 consecutive months: June, 1975, December, 1975, and March, 1976. There was apparently a preponderance of diatoms (chrysophyceae), with the green algae (chlorophyceae) more common than the bluegreen algae (cyanophyceae). There were two genera of the euglenophyceae reported as well.

Zooplankton

The Des Plaines River Aquatic Study (1978) introduces its zooplankton survey results as follows: "Zooplankton are mainly microscopic animals, suspended in water. They rely on water for food, oxygen and movement. Running water soon empties itself of zooplankton unless there is a continuous source from outside waters. Places suitable for continuous plankton reproduction are sluggish weedy areas along the shore, eddies, backwaters, sloughs, ponds, marshes and lakes connecting with the river. The river's actual effect is to modify the plankton population received from these other sources. Plankton variety and richness depends on the breeding ground; if the plankton supply is not sufficient to consume

all available food material in the river, some of its fertility will be wasted. Also, if the breeding grounds produce plankton not suited to existing river conditions, these organisms may not be present in large numbers.

The only data available on zooplankton populations from the region are those provided by the invaluable Des Plaines River Aquatic Study, (1978). The data are interesting to a point, but without a body of correlative data, it is not wise to derive fundamental conclusions about local populations in the Des Plaines River at the project site.

Table 9 (see Appendix) is a list of the zooplanktonic species recorded by the aquatic study, including a summary of the percent of each kind of organism in the year's sample at McCarthy Road (Town Line Road). There was a reasonably high diversity of rotifers, a datum which reflects the adaptability these animals display for seasonal variations in their milieu (see King, 1971).

In addition the aquatic study also found a routinely significant presence of copepods and cladocerans which suggests that the waters at McCarthy Road (Town Line Road) are not strongly polluted. It was also found that for most of the year, rotifers and copepods are the predominant zooplanktonic individuals.

Amphibians and Reptiles

Nothing has been recorded concerning the amphibian and reptile fauna of the project site specifically, but the Lake County Forest Preserve District has compiled a list of the species known from the Des Plaines River Valley of Lake County. The secretive, often fossorial or nocturnal habits

of these animals make the compilation of local inventories quite difficult.

With the exception of the red-eared turtle (Psedemys scripta elegans, excluded from the region by Smith, 1971) any one or all of the taxa in the District's records could be living in the project site. There are about a dozen others known from the region (Smith, 1971); any one or more of these might find habitats in the study area suitable. Table 10 (see Appendix) lists the taxa on the Lake County Forest Preserve's list; annotations are appended which describe generally their habitat.

Mammals

No attempts have been made to circumscribe the mammal population of the study site specifically, but the Lake County Forest Preserve District has made a list of the mammals observed in the Lake County portions of the Des Plaines River Valley. The District's records seem relatively complete and are provided in Table 11 (see Appendix) along with brief annotations regarding habitat. Any one or all of these mammals could live in the project site.

Birds

The birds of the project site are poorly documented, though the Lake County Forest Preserve District noted and recorded 66 species (Table 12, Appendix) during the years 1975-77. The habitats of the area are fairly numerous, so the potential bird population is quite rich. Insofar as the actual composition and manifestations of the contemporary bird population of the project site, speculation must suffice.

With the help of Swink (1976) a somewhat enriched list can be extrapo-

lated. The slate-colored junco, downy woodpecker, and bob-o-link, for example, can be added with reasonable certainty. Many of the birds listed in Table 12 are wayward visitors or perhaps summer residents, if there at all. Importantly, there is no information as to which birds nest at the site but extrapolating even a bit further, reasonable guesses can be made as to which birds these might be.

The evidence indicates that the project site would potentially be a rich habitat were water quality improvements to occur and the vegetal mix to be diversified.

PUBLIC ACCESS

During the 1970s the Lake County Forest Preserve District acquired considerable floodplain acreage along the Des Plaines River, to the extent that an almost continuous greenbelt extends the length of the county. The District's effort in this area in the last decade has concentrated on acquisition rather than development and, while some of its older Des Plaines holdings (such as Van Patten Woods, Daniel Wright Woods and Ryerson Conservation Area) are fully developed for access by the public, many of the floodplain lands are relatively inaccessible. This is true for the project site.

The northern half of the site contains the public access facilities that are currently available. At the northeastern corner of the site (at the District's boundary to the south of Wadsworth Road) is a parking lot, canoe launch, fishing pier and observation deck. From this point a trail proceeds south, crosses the Des Plaines with a newly constructed

bridge on Town Line Road (McCarthy Road) and proceeds north again back to Wadsworth Road. On this western bank the trail connects to the northern holdings of the District where, in Van Patten Woods, more parking facilities are available. Those are the extent of access facilities; the southern segment of the site is undeveloped.

Potential access to the site, however, is good. Route 41 flanking the western boundary, is a four-lane highway, and although Town Line Road (McCarthy Road) has been closed off to vehicular traffic from Route 41 by a Forest Preserve District barrier, it is still a serviceable roadway. An unpaved track accessible to vehicles leads south from this to the middle and southern gravel pit lakes but at present only District vehicles are able to use it. It is the plan of the Forest Preserve District to improve access by trail in the southern half of the site, linking it to the Gurnee Woods holding to the south and completing another segment in the overall goal of a continuous trail along the Des Plaines River floodplain in the County.

The northwestern quadrant of the site is highly visible from Route 41; in fact, the northern gravel pit lake which is adjacent to the main road attracts shoulder parking near the Town Line Road (McCarthy Road) barrier. The rest of the site, except the areas adjacent to Wadsworth Road, are removed from the public eye; they are screened by privately held land adjacent to Routh 41 south of Town Line Road (McCarthy Road) and by the railroad embankment on the eastern boundary.

PUBLIC USE

As might be expected, the northern half of the project site receives

most use. The trail is used by walkers, horses, cross-county skiers, and snowmobiles; the latter use is particularly heavy when winter weather is appropriate. The site as a whole is used for a wide range of recreational activities and while not heavily used, it is consistently used. The parking lot at Wadsworth Road has a 22-car capacity and it is usually at least half full. Lake County Forest Preserve District personnel estimate an average daily use by 50 to 75 people.

In addition to the trail uses noted above, the site is a popular fishing area, particularly the three gravel pit lakes. The northernmost, adjacent to Route 41 is the most accessible and at least one fisherman is invariably to be seen there. The middle gravel pit lake is a popular spot for ice fishing in winter and in the summer both interior lakes (middle and southern pits) see a number of users who either walk in or gain access by mini-bike. While the lack of access is a deterent to many people it is attractive to others, particularly younger users.

The river itself does not presently offer great potential to the recreationist. Certainly it is not attractive to swimmers and while it is fished, the gravel pits offer greater attraction. North of Wadsworth Road, canoeing is a relatively popular activity. However, in the project site reach the river contains many snags which capture debris, making for interrupted paddling. The boat launch at Wadsworth Road would be more attractive were the river channel to the south less clogged.

For largely undeveloped public land, the site already affords considerable use, the range of which serves to point out the area's potential. Were the river and lakes to be enhanced, access provided in the southern seg-

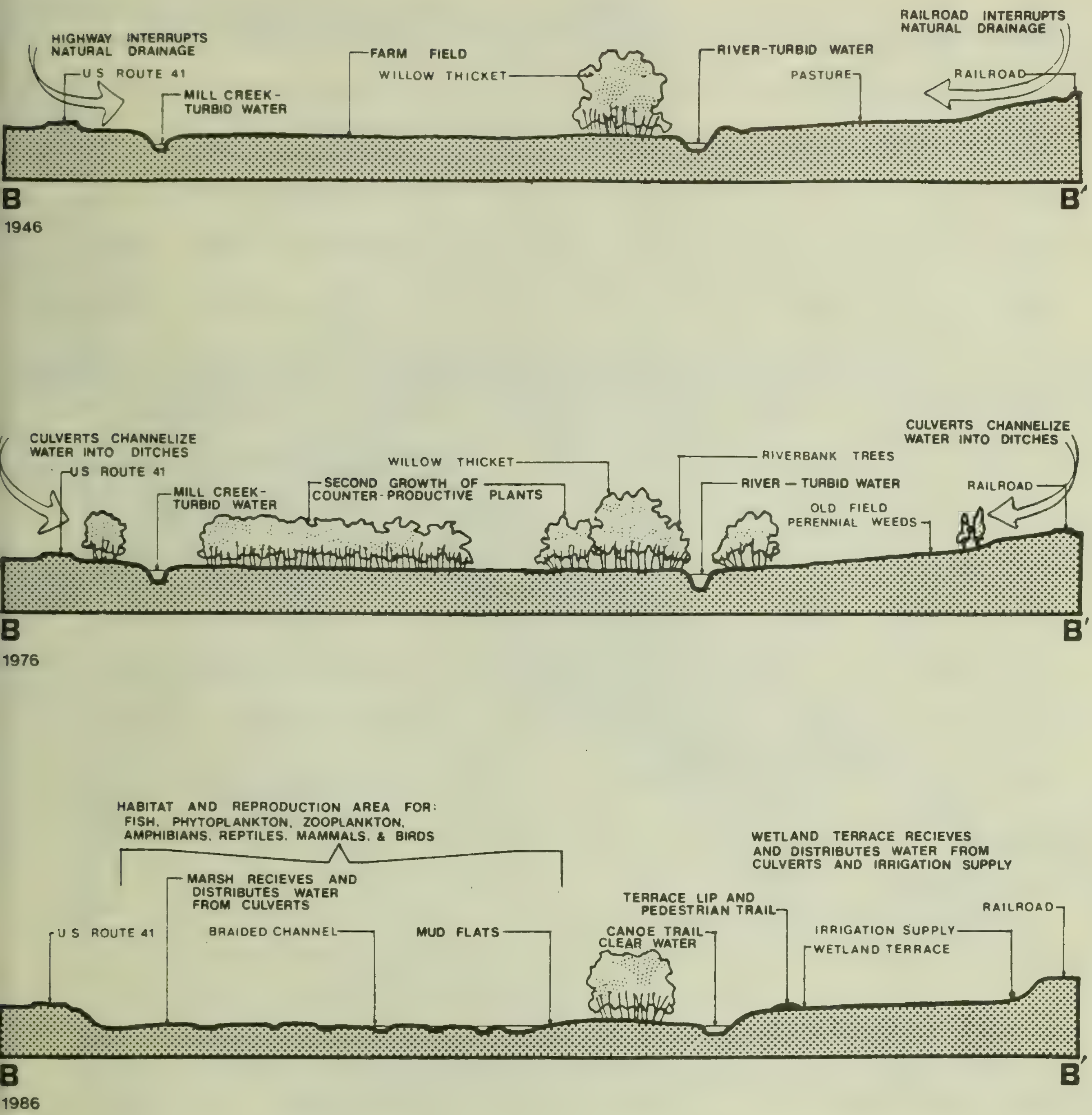
ment, and trails linked with holdings to the south, the site would become a well-used component in the District's Des Plaines River Trail.

CHAPTER IV
Conceptual Plan

As the last chapter has shown, the Des Plaines River, its floodplain and its watershed have undergone a good many changes in the last century. The conceptual plan laid out in this chapter proposed further changes to the site but these are changes that will bring the river and its lands back once again to their original scheme: reproducing the resources of the past and restoring them to their former flexibility and diversity.

A summary of the plan is shown in Figure 6 which illustrates three cross sections of the site as it has been (and is proposed to be) changed through time. Unfortunately, detailed information on the site before man made alterations does not exist so the earliest section, showing the state of the site in 1946, indicates a man made landscape. The two major impediments to drainage (Route 41 and the railroad) were by this date in place and the previously marshy floodplains of the Des Plaines River and Mill Creek had been drained for farming; the stream had been confined and channeled. The second section demonstrates the situation in 1976. Farming by this time had ceased and second growth woodland had sprung up along with old field vegetation. The streams are still confined to unnaturally straight and limited channels.

The third section dated 1986, demonstrates the major features of the conceptual plan. The land surface has been resculptured and lowered; to the east (the right side of the cross-section) the river terrace of the Des Plaines has been leveled to a very gently sloping wetland terrace, while to the west (the left side of the cross-section) Mill Creek has been braided into an number of



SECTIONS B – B′
1946 PROJECTED TO 1986
SHOWING CHANGES OF
SITE CONDITIONS

0 400 800 ft.
VERTICAL EXAGGERATION -- 4:1

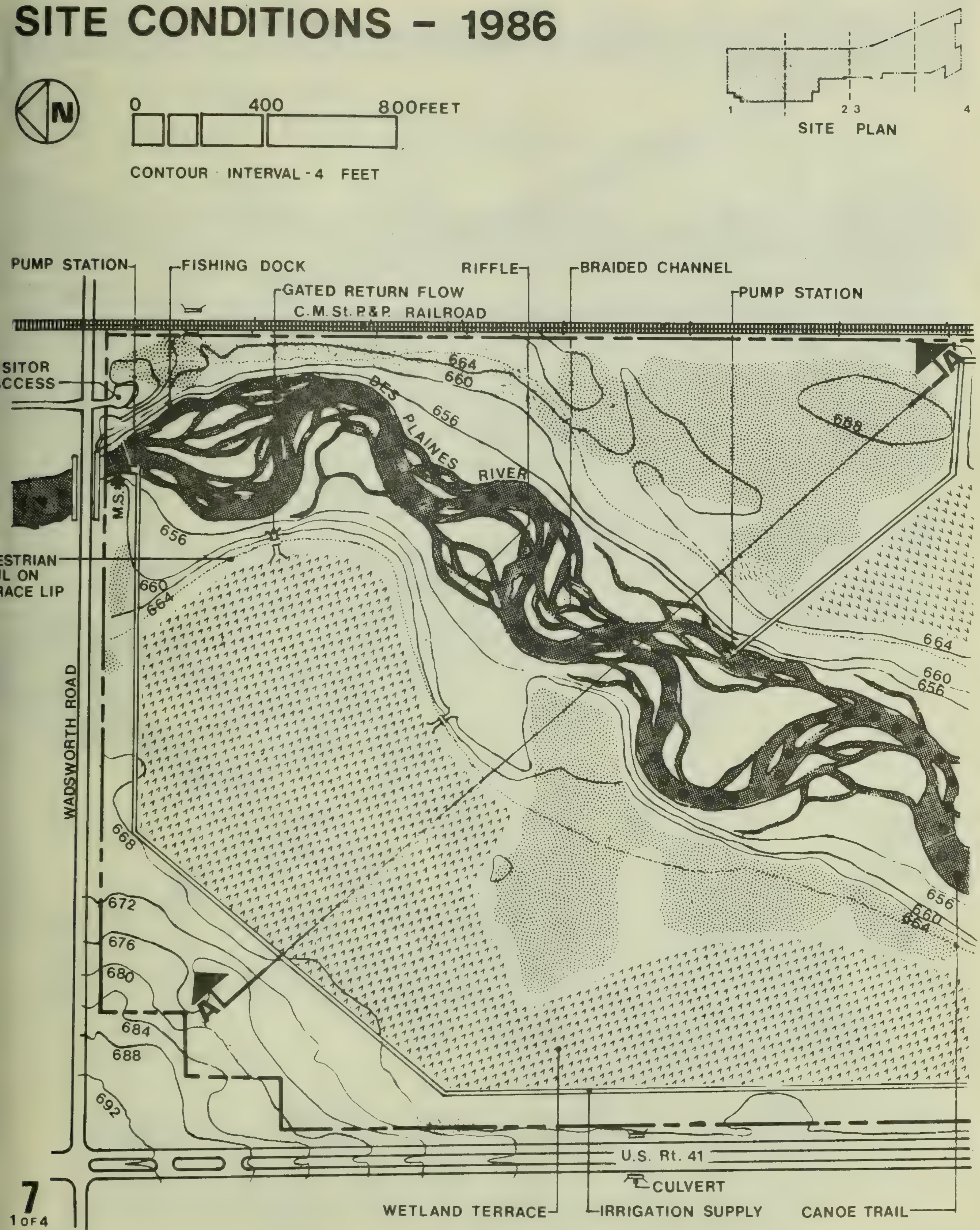
FIGURE 6

channels to become a marsh, with the land level considerably lowered. Water is supplied to the wetland terrace from the Des Plaines River by an irrigation system and the river channel itself is somewhat shallower and wider. The marsh receives water from culverts and also from the braiding of Mill Creek which redistributes water from the former channel, bringing it into contact with more land surface. Long established stands of native vegetation (the willow thicket, for example) remain; however on the wetland terrace and in the marsh itself appropriate native vegetation is re-established to encourage a natural diversity and improved habitat. Furthermore, improved public access is planned; a pedestrian trail is maintained along the lip of the river terrace and the Des Plaines River channel is designed for a canoe trail. The situation described in the third section (1986) provides an environment much closer to that of 1886: the natural habitat is diversified; water distributed across the land allows for greater nutrient uptake by a marsh vegetation and for entrapment of silt; water quality is improved while the land is enriched. Flood peaks are attenuated by the increased flood storage.

LANDFORMS

A review of Figure 7 reveals detail of the proposed landform changes. The most dramatic change is in the Des Plaines River channel. The floodway is seen to be considerably widened -- to about 600 feet from 150 feet. The river channel has been braided to allow backwaters to form on the widened floodway; however the former main channel is still defined. The river's course is changed only to connect it into the northernmost gravel pit lake. At the edge of the floodway there is a pronounced lip

FIGURE 7: SITE CONDITIONS - 1986



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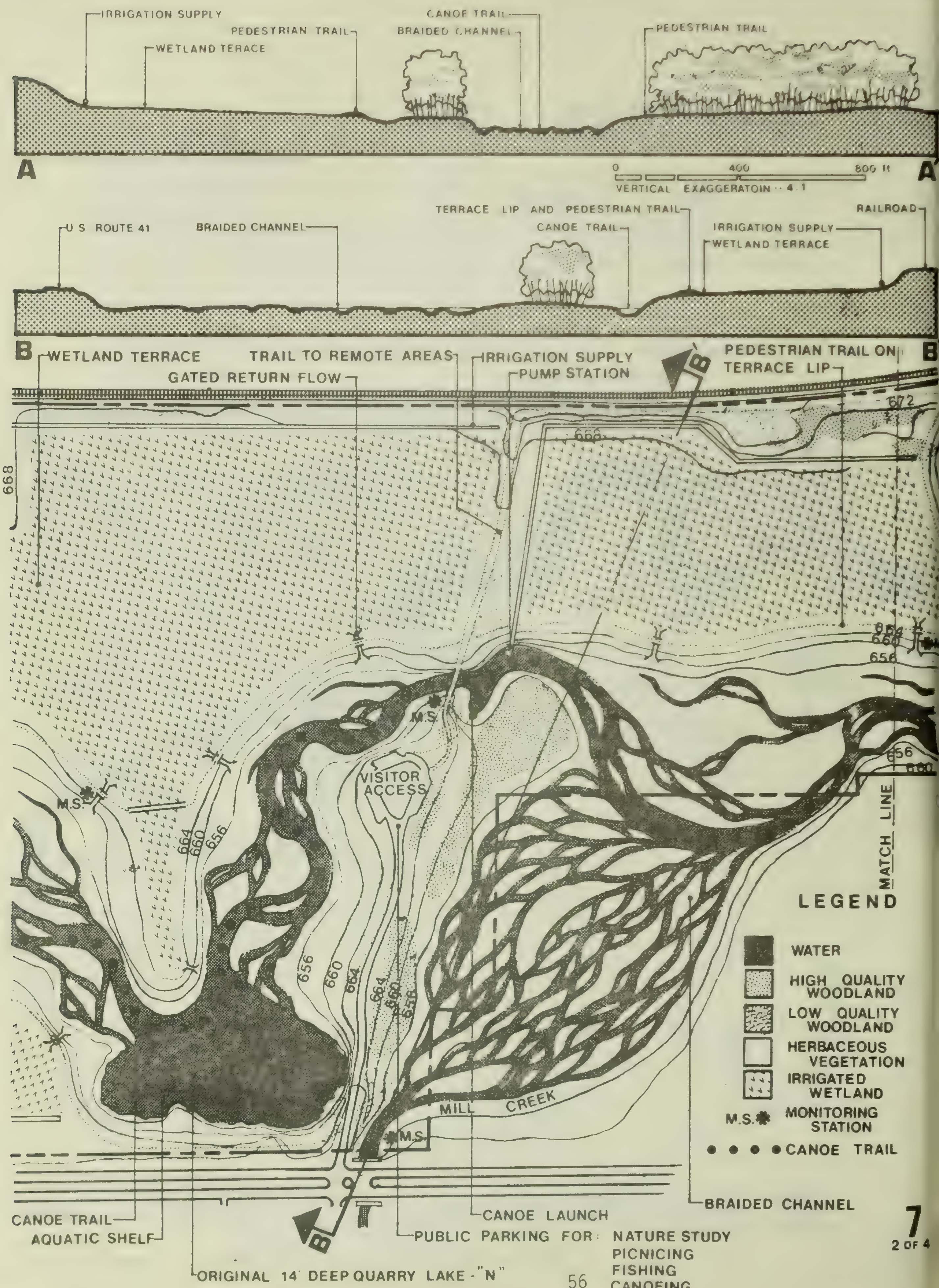
1 OF 4


IRRIGATION SUPPLY
PEDESTRIAN TRAIL
WETLAND TERACE
CANOE TRAIL
BRAIDED CHANNEL
PEDESTRIAN TRAIL
A
A'
0 400 800 ft
VERTICAL EXAGGERATOIN - 4:1
TERRACE LIP AND PEDESTRIAN TRAIL
RAILROAD
U S ROUTE 41
BRAIDED CHANNEL
CANOE TRAIL
IRRIGATION SUPPLY
WETLAND TERRACE
B
B'
WETLAND TERRACE
TRAIL TO REMOTE AREAS
IRRIGATION SUPPLY
PUMP STATION
PEDESTRIAN TRAIL ON TERRACE LIP
GATED RETURN FLOW
668
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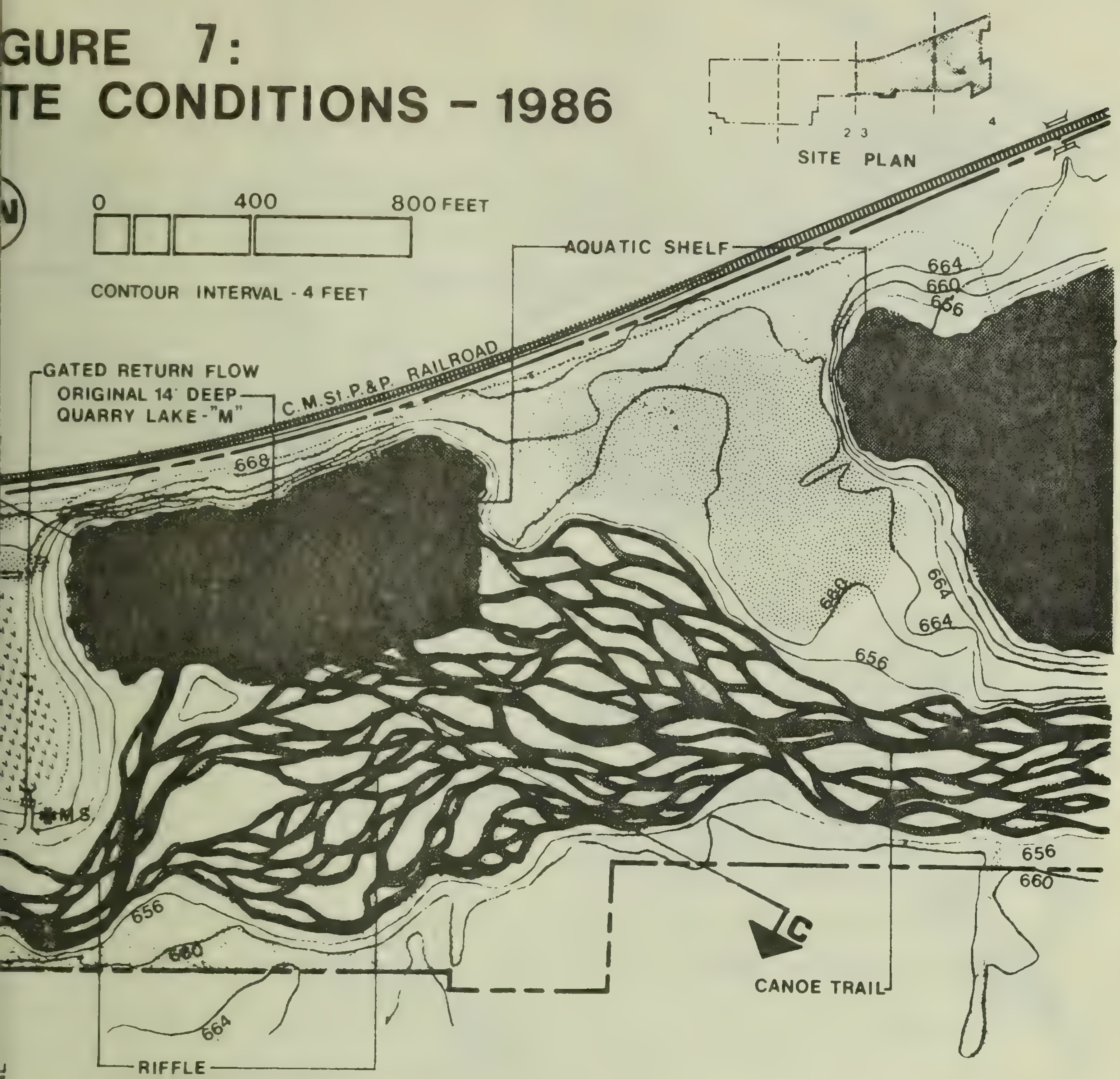
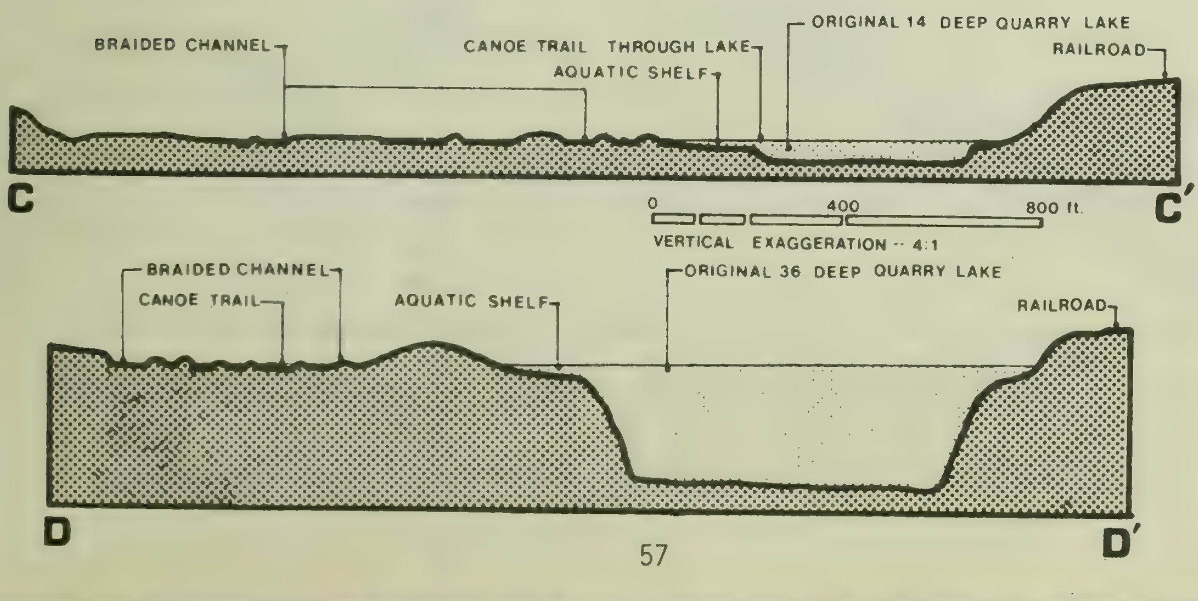
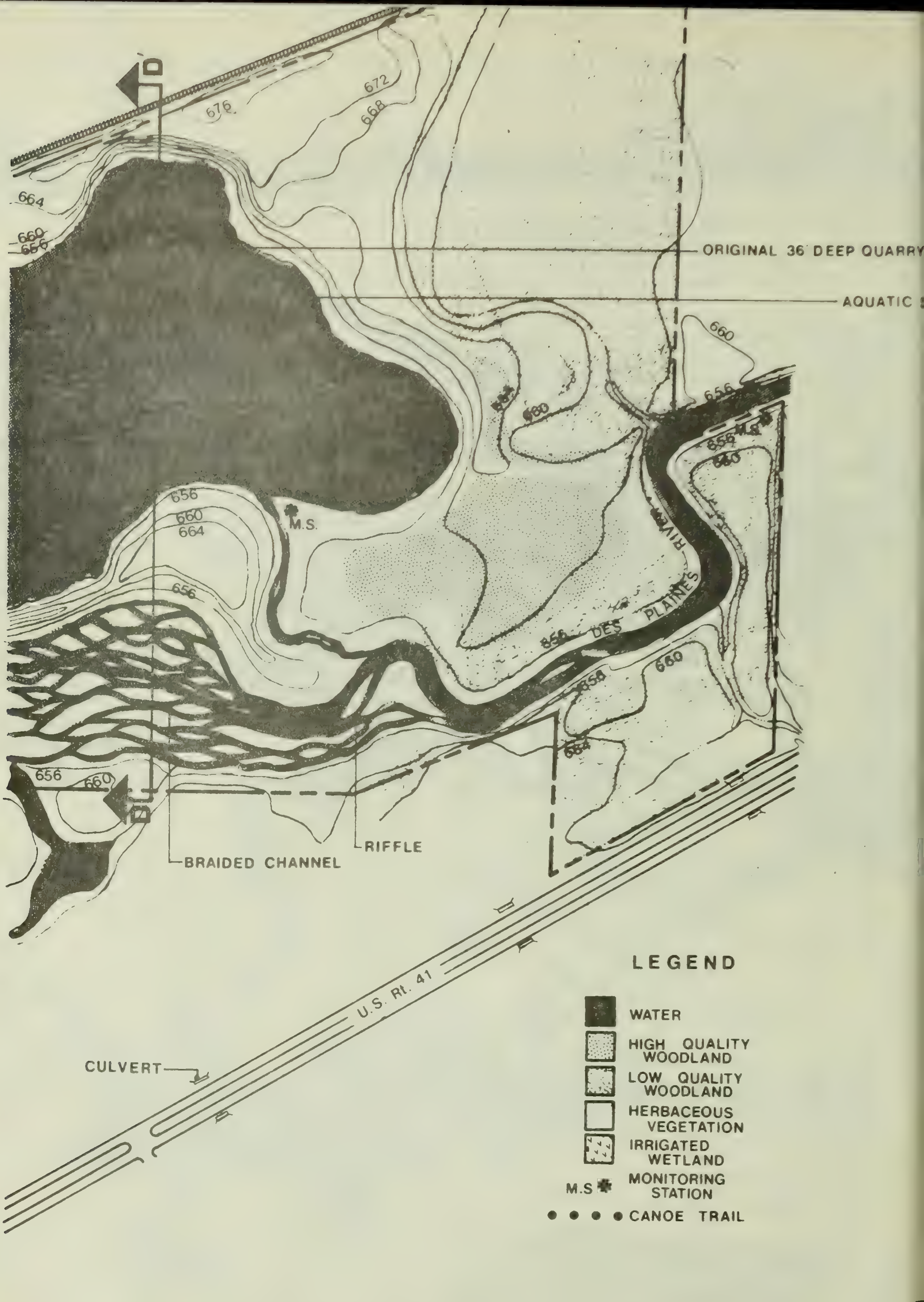
664
660
656
M.S.
VISITOR ACCESS
MATCH LINE
LEGEND
WATER
HIGH QUALITY WOODLAND
LOW QUALITY WOODLAND
HERBACEOUS VEGETATION
IRRIGATED WETLAND
M.S. MONITORING STATION
CANOE TRAIL
MILL CREEK
CANOE TRAIL
AQUATIC SHELF
ORIGINAL 14' DEEP QUARRY LAKE - "N"
CANOE LAUNCH
PUBLIC PARKING FOR: NATURE STUDY
PICNICING
FISHING
CANOEING
BRAIDED CHANNEL
7
2 OF 4

GURE 7:
TE CONDITIONS - 1986






ORIGINAL 36' DEEP QUARRY
AQUATIC
676
672
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664
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656
M.S.
DES PLAINES RIVER
BRAIDED CHANNEL
RIFFLE
CULVERT
U.S. Rt. 41
LEGEND
WATER
HIGH QUALITY WOODLAND
LOW QUALITY WOODLAND
HERBACEOUS VEGETATION
IRRIGATED WETLAND
M.S MONITORING STATION
CANOE TRAIL

defining the edge of the newly formed river terraces (the existing Forest Preserve District trail was used to define this) which are extensive in the northern section of the site. These terraces are very nearly level, their slope being only 1 foot in 800 feet (to allow slow overland flow of river water pumped through the irrigation system) and extend away from the lip for approximately 800 feet on either side of the river.

In the southern section of the site the Des Plaines channel and floodway are treated similarly by widening and braiding; however, the same river terrace treatment is limited by the existence of the gravel pit lakes and remnant woodland areas which are left in place. The river is connected only to the southernmost gravel pit lake and only by a lake outflow channel which would receive inflow only during high flows.

The general configuration of the gravel pit lakes was accepted but around their existing shores an aquatic shelf is proposed. This would be accomplished by limited excavation along the shore to allow shallow water environments for emergent plant growth. In the case of the southernmost lake, the aquatic shelf enlargement combines a small ancillary gravel pit to become unified with the larger lake.

Mill Creek, as it emerges from the culvert under Route 41, is proposed as a highly braided channel in order to support a marsh. (Note Chapter III, Figure 3 which indicates a marshy area in this location in the presettlement vegetation.)

All these changes are designed to create the changed environment with as little disturbance as possible in order to minimize both cost and environ-

mental damage. New landforms were dictated by remnant woodlands, by existing or remnant water courses, by the gravel pits and even, as noted above, by the existing Forest Preserve District trail. The elevations of the railroad and the roads on two sides were constraints for the topographic alterations which had to fall between these elevations and the base level of the invert of the river and the creek. Soil grades in the existing woodlands are unchanged in the plan.

SOILS

The soils at the site have long been excluded from frequent inundation by water and the plan has considered the steps necessary to create wetland soils. The wetland river terraces will not require a specifically wetland soil as existing topsoil will suffice. Topsoil will, however, need to be removed before earth moving and construction begin and to be preserved for later replacement. After subsoils have been graded it is also felt that in the marsh area the original topsoil can be used as the basis for the wet soil that will develop from both the moist conditions and the new vegetation assemblage. The only perceived difficulty with soil is in the aquatic shelves where pockets of organic, mucky soils may have to be introduced as a necessity for the new emergent plant stock to develop.

HYDROLOGY AND WATER QUALITY

To regain the attractiveness of the Des Plaines River, to provide for a healthier and a more desirable aquatic life, to reap the environmental benefits that the river once provided, four water-related changes need to be made:

1. The fluctuations in flow and stream depth need to be moderated

2. Turbidity and suspended solids need to be reduced

3. Nutrients need to be balanced

4. Dissolved oxygen needs to be increased, particularly during the warm summer months

These changes are incorporated in the plan through the following guidelines for modifying and managing the river:

1. Increase the river's surface area and reduce its depth

2. Increase the area and time of contact between the river and attached plants

3. Avoid overloading the river with waste materials, toxic or otherwise

The last should go without saying but there is a point to be made here. It is likely, even given the greater waste load which the river receives today, that the river could handle the current load and then some, if it had not been physically altered. The waste load and the assimilative capacity of the river must be carefully balanced if the overall benefits of the stream are to be realized. Changing the waste load will affect the quality of the river, just as changing the river's ability to treat the waste affects its water quality. The issue that is central to the proposed plan is the enhancement of the river's own waste assimilative capacity. Management of the waste load should not be neglected but, for the project site, the river could assimilate without loss of benefit, the existing waste load if only the river were broader, shallower and had greater contact with wetlands and riverine plants.

If the guidelines are followed as proposed, in addition to the water quality changes, several other benefits will accrue:

1. Flood flows will be attenuated

2. The seasonal distribution of streamflow will be modified and improved

3. The diversity of habitat and wildlife will be increased

4. The aesthetic appeal of the site will be enhanced

Reducing the depth of the river and increasing its contact with plant life are accomplished by lowering the stream banks and spreading the stream channel over a wider area. Additionally, the quantity of water in the stream channel is reduced by diverting it to the expanded floodplain. The modifications are illustrated in the conceptual plan: the stream channel is changed and the water is redistributed to the river terraces by pumping. Both modifications expand the area through and over which the water flows, reducing the depth of flow while increasing the time and area of contact between the water and plant life.

One of the principal benefits derived from the conceptual plan is that of flood control. By lowering the banks and removing old levees, and by providing additional floodplain storage, flood waves passing through the project site will be attenuated, resulting in lower flood stages downstream. Eighty to 150 acres of wetland terraces would be created. Most of the proposed excavation would occur between 655, the elevation of the river bed, and 668, which is the approximate elevation of the 100 year flood. The cuts and fills will be contoured to enhance flood storage. Anywhere from 800 to 1200 acre-feet of additional flood storage could be created depending on the extent of excavation.

Further, the proposed plan will modify the hydrologic regime not only by

mitigating flood flows but also by changing the seasonal distribution of flow. Under the current regime, the water flowing through the project site is confined to very narrow channels offering little opportunity for storage, infiltration, groundwater recharge and evapotranspiration. The proposed scheme will increase evapotranspiration and the opportunity for infiltration and recharge. Water lost to increased evaporation and transpiration should amount to no more than one cubic foot per second. Lack of information on the shallow groundwater makes it unclear how much water will be lost to groundwater recharge but, once the soil is saturated, much of the irrigation water will return to the river as base flow. Low flows during the fall should be increased by the storage of water on the irrigated wetland terraces and in the shallow groundwater and by the reduced evaporation and transpiration occurring at that time of year. This will be a benefit to the river in the late summer and fall when stream temperatures are normally high and flow and dissolved oxygen are low.

The proposed scheme will greatly reduce the velocity of water moving through the site. In turn, this will increase the detention time which will provide greater opportunity for sediment settling and nutrient uptake. Currently, at a flow rate of 100 cubic feet per second (assuming a typical river cross section of 60 feet wide and 2 feet deep, having a roughness factor of 0.04) the average velocity is 0.8 feet per second. The modifications would be designed to achieve an average velocity of 0.06 feet per second. Accordingly, the detention time would be increased from approximately 5 hours to 3 days. This would be achieved by increasing both the area and roughness of the stream channel and by detention of water on the irrigated wetland terraces. The later would be designed to handle a loading of 25 cubic

feet per second and detain it for 3 days. This would mean that the depth of water on the wetland would have to be one foot, given 150 acres of irrigated land. Based on experience in other areas (U.S. Environmental Protection Agency, 1978 and 1980) these conditions are reasonable. At higher flow rates, the average detention time would be reduced as a higher and higher percentage of the flow moves through the channel bypassing the wetlands. Even under these conditions, the proposed channel modifications would still allow for an average detention time of greater than one day.

Both the proposed wetland and channel modifications greatly expand the area over which the water flows, thereby reducing its depth and velocity while increasing the contact between the water and plant life. Given these modifications, turbidity would be reduced because of the lower average velocity per length of river and the filtering action of the plants and the plant litter.

Given a lower velocity, greater settling time is afforded for the removal of suspended matter. In addition, less energy is available for entraining particles already settled. Further, by reducing the depth of flow, the suspended particle has a shorter distance to travel before it is removed from the water column. Therefore, by simply expanding the area of flow in a given reach, greater settling should take place and consequently turbidity and suspended solids reduced. This of course assumes that the suspended material is settlable (that the suspended material has a density greater than that of water). However, as noted earlier, the majority of the suspended material is silt and clay, both of which have greater densities than water, and therefore they would be expected to settle or be

filtered out.

Bringing the water into contact with plants has several advantages. It reduces the river's velocity by increasing the surface friction or resistance to flow. But in addition, the plants and plant litter act to filter out particles trapping them on their stems, leaves and root systems. From what little experience exists with the use of plants as filters (U.S. Environmental Protection Agency, 1980; Kadlec, et. al., 1979), it appears that they do not greatly affect the total suspended solids load; however, the characteristics of the load would be expected to change. Larger suspended solids, primarily of plant litter, would be expected to replace the fine suspended mineral matter. The total weight of suspended solids may not change but the water's clarity would improve with the removal of fine suspended material because the projected area per mass of particle would be reduced. More importantly, the seasonal distribution of suspended material would be changed. The suspended load should be less during the summer period when plants are growing and their leaves are firmly attached, preventing organic matter from being washed away. Furthermore, algal populations should be greatly reduced because flow will be distributed over a much wider area, generally moving at the level of the plant roots shaded by the grasses and forbs. The lack of sunlight and the competition from other plants for nutrients should greatly limit the magnitude of algal populations and therefore reduce turbidity.

By spreading out the river and reducing the extent of exposed, steep river banks, the depth of the river will fluctuate less for a given change in discharge, creating a more stable hydraulic environment. This should help

riverine plants to survive and propagate and should support a gradation of plants in accordance with the degree and frequency of innundation. The plants will be better able to hold the soil of more gradually sloped banks, trapping silt and suspended material attempting to move downstream. With the elimination of exposed, steep banks, the potential for clay and silt to be entrained will be reduced; consequently, less will be transported downstream.

Nutrient control, based on the proposed plan, will be that of the natural control exerted by an aquatic ecosystem. During the growing season, nitrogen, phosphorous and the other nutrients necessary for plant growth will be fixed in plants and used by them on the site. In the fall and winter as the plants die and decay the nutrients will be released to move on downstream in the spring. During the fall, winter, and early spring, higher levels of nutrients in the surface waters present little or no problem since temperature limits the possible development of deleterious algal blooms. Based on limited experience in other parts of the country, a 70 to 90 percent (Kadlec, et. al., 1979; Reed, et. al., 1970) reduction of nutrients should be achieved. But, what is of greater importance is not only that the nutrients are reduced but that the life system is brought into balance.

The conceptual plan will greatly enhance the water's oxygen resources by two means. First, by spreading the stream out and distributing the water over a larger area, the atmospheric/aqueous interface is greatly expanded and the depth of penetration reduced. This, as well as man-made riffles, provides for greater reaeration, the stream's principal source of oxygen. Secondly, the shallower waters afford greater light penetration permitting the growth of rooted and attached plants which in turn shade the water, keeping it cooler and supporting higher dissolved oxygen. Conversely, high temp-

eratures reduce the solubility of dissolved oxygen thereby limiting the amount that can be stored in the water.

VEGETATION

The site inventory revealed that in general the site supports a limited vegetation very greatly affected by man-made changes. Not only is native plant diversity low, but the native species are widely dispersed. None of the original floodplain wetland vegetation complex is exhibited at the site at the present time. The conceptual plan's intent is to maximize the natural wetland potential of the river's floodplain and to do this without compromising those existing life systems which are already relatively natural in terms of their presettlement floristic integrity.

The kind of vegetation which is developed in the wetland restoration will be fundamental to the success of the concept but there are many wetland scenarios, and several rationales could be justified. For example, large mud flats could be developed, dominated by those plant species, the attributes of which were extolled by Bellrose (1941) and Bellrose and Anderson (1943), which encourage the visitation of waterflow generally and game birds in particular. Alternatively, a wetland system could be devised to favor a proliferation of game fish -- a rationale which certainly would please fishermen.

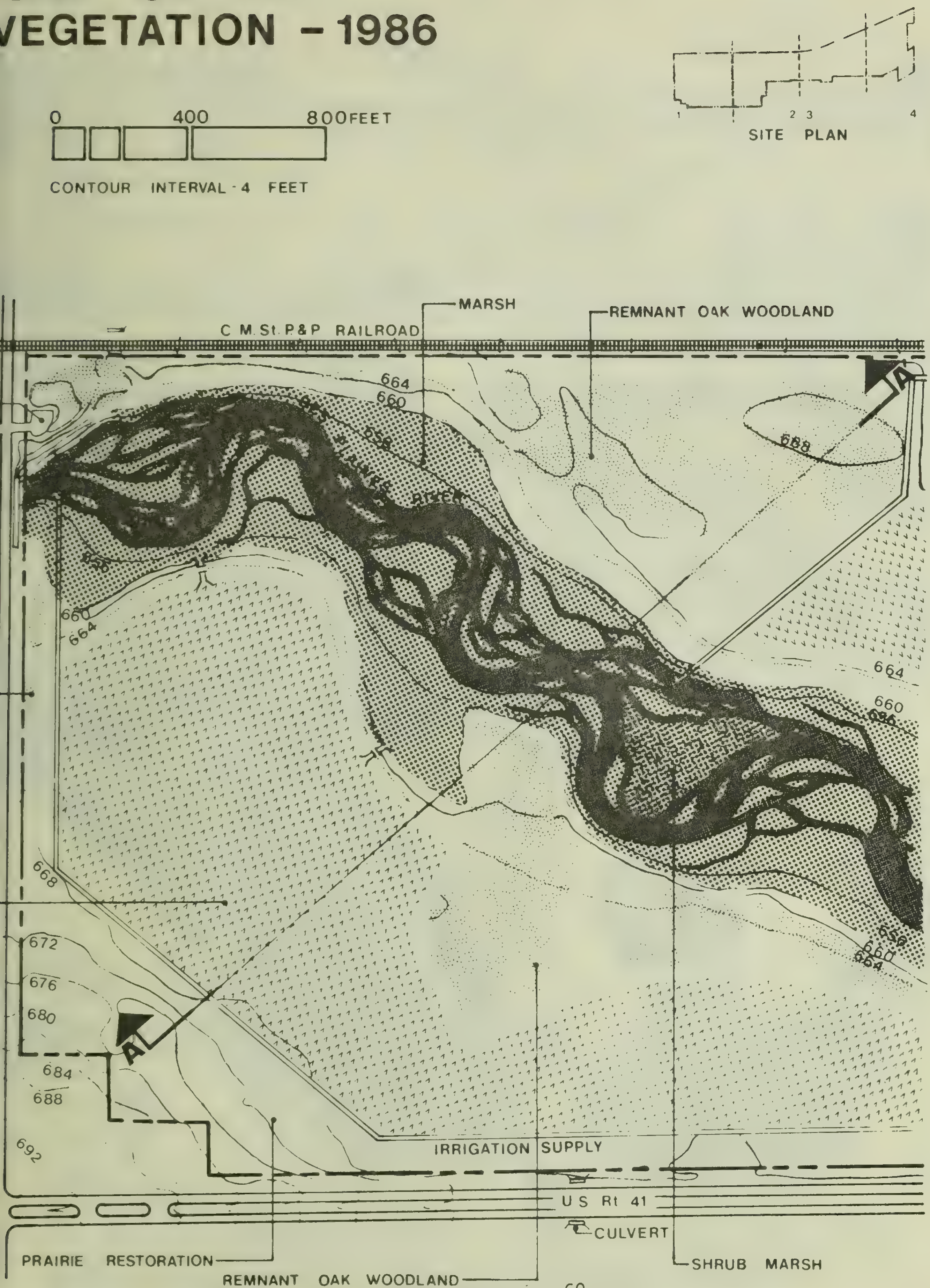
While these examples, and some others, would accomodate specific purposes, the rationale of the conceptual plan is the accomodation of a wide range of purposes and not the emphasis of any one particular aspect. Indeed, when a life system is designed around the parameters of habitat suitability for only one specific animal, the idea which spawned this wetland restoration concept

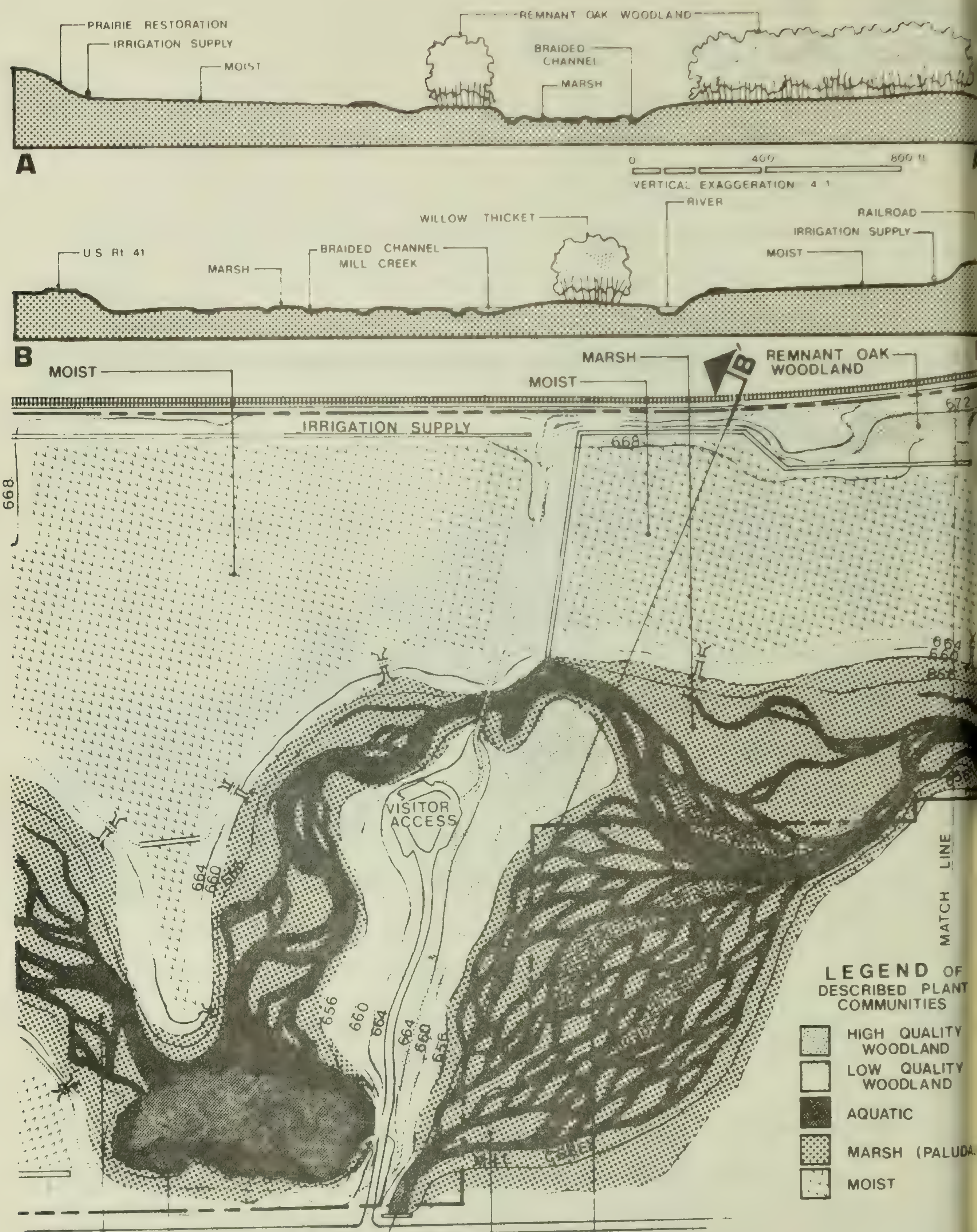
is lost. The ultimate goal is to build a natural wetland in the prairie milieu. The aim floristically, therefore, is to develop a life system which is rich in native wetland, particularly perennial, species and to govern the flow of water so as to encourage the development of large prairielike marshes and fens, the land undulating here and there with grassy swales and shrubby sloughs. The goal is, as much as possible, to recreate a facsimile of the floristically diverse wetland life systems which filtered and cleansed runoff waters in their slow trek toward the Illinois River during presettlement times.

The general revegetation plan is shown in Figure 8. Five distinct habitats are included: woodland, prairie, moist river terrace, marsh, and aquatic. All the significant woodlands existing on the site at present are retained in the revegetation plan; these are of either high or low quality. The high quality woodlands are retained for obvious reasons; they are well-established and contain whatever remnants of the natural system remain from presettlement days. The low quality woodlands are either old, grazed oakwoods, or are relatively recent second growth from old field succession which occurred after farming on the site was abandoned. These are being retained not for any inherent quality but to provide a vegetal net to help to mitigate disturbance and also because they are a part of the contiguous plant communities; their quality can be expected to improve both with time and proximity to the newly diverse communities that will be established.

In the northewest corner of the site, above the level of the irrigation supply line on drier ground, a prairie restoration is proposed. This allows for greater plant diversity and will provide a more stable niche for the establishment of prairie plants, some of which might, with time, extend their range

URE 8:
VEGETATION - 1986




PRAIRIE RESTORATION
IRRIGATION SUPPLY
MOIST
REMNANT OAK WOODLAND
BRAIDED CHANNEL
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VERTICAL EXAGGERATION 4:1
RIVER
RAILROAD
IRRIGATION SUPPLY
MOIST
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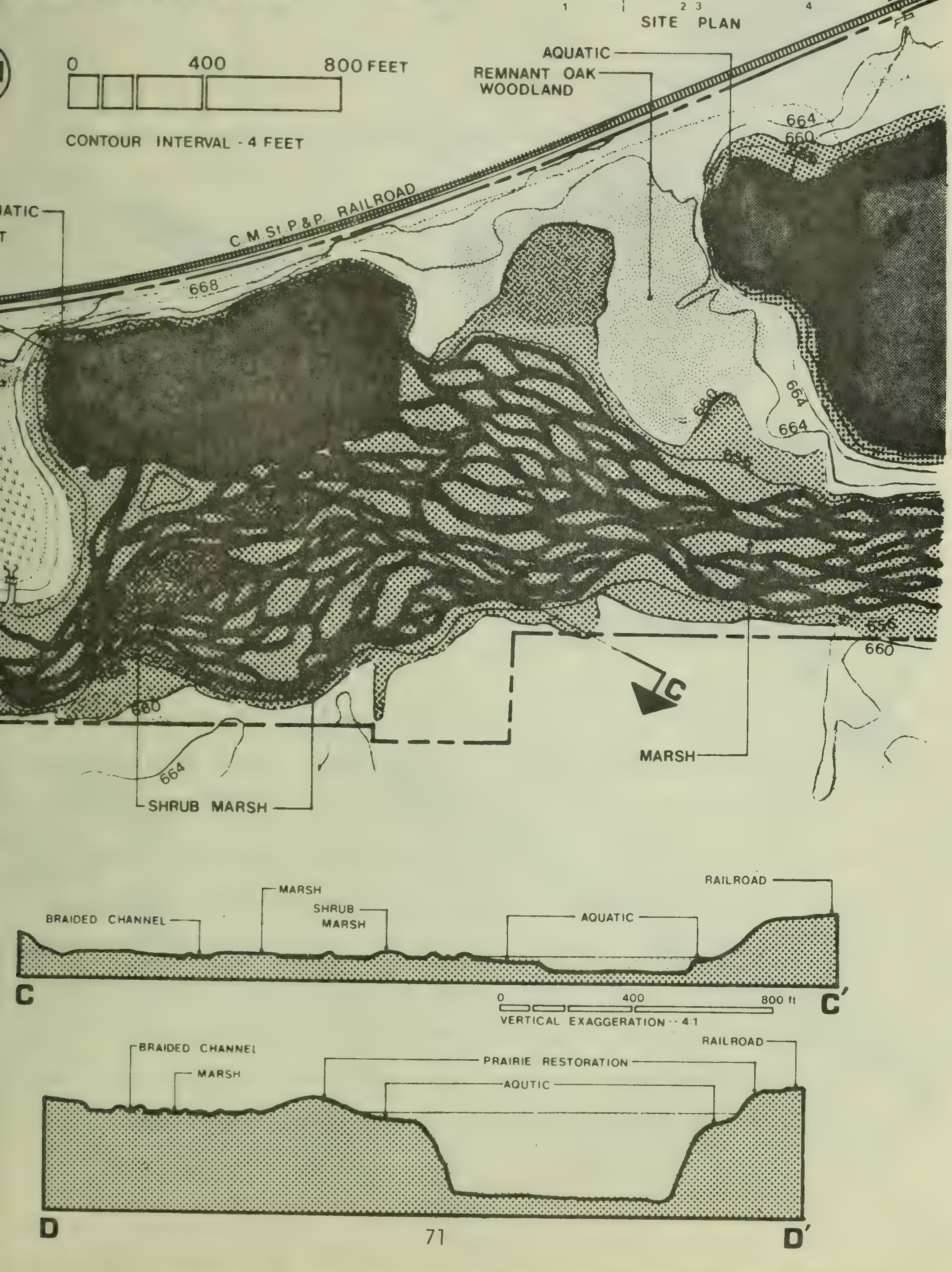
GURE 8:
VEGETATION - 1986




PRAIRIE RESTORATION
WOODED SWAMP
AQUATIC
WILLOW THICK
REMNANT WOO
FLOODPLAIN
PRAIRIE RESTORATION
U.S. Rt. 41
CULVERT
LEGEND OF DESCRIBED PLANT COMMUNITIES
HIGH QUALITY WOODLAND
LOW QUALITY WOODLAND
AQUATIC
MARSH (PALUDAL)
MOIST
676
672
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4 OF 4

to the moister conditions of the river terrace.

The moist irrigated river terraces, the floodway marshes and the aquatic shelves around the gravel pit lake shores provide a range of habitats for a range of water-loving plants: from those able to thrive in moist soils to those able to tolerate submergence. This moisture range allows for ample choice in species selection and for experimentation possibilities to gauge plant tolerances.

Controlling the revegetation of the site is an enormous problem, one over which there is only limited sway. The revegetation process takes place within the synecological context of the Des Plaines River valley in Lake County, Illinois. The plant species of which the potential vegetation will be composed are limited to those which are known to inhabit moist to wet, non-acidic soil conditions locally. There are over 400 such plant species known from Lake County (see Swink & Wilhelm, 1979).

These species are not all uniform in their habitat requirements. That is to say that it is not simply a matter of chance as to which of the 400 will reinhabit the site after the engineering phases of the restoration. Some species are fussier than others as to where and under what conditions they will grow. About 20 to 25 percent of the species are likely to pop up just about anywhere in moist disturbed soils whether planted there or not. Generally, these species have been rated on the autecological scale of -3 to +3 by Swink and Wilhelm. These species are listed in Table 13 (see Appendix) along with information concerning their habitat. Those species listed in Table 13 (and Table 5) are the most likely to volunteer in the restoration.

At the other extreme, there is a group of plants (approximately another 20 percent) which require stable, native, essentially undisturbed soil conditions. Often they are now considered by local botanists to be quite rare, and they have been given autecological ratings of 9,10,15 or 20 by Swink and Wilhelm. It is highly unlikely that any of these species will volunteer in the site and only the most optimistic would endeavor to sow these species in a synecologically new wetland sytem. These species are listed in Table 14 (see Appendix). As a relatively stable floristic system is achieved in the revegetation process, and as controlled fire as a management tool begins to become possible, attempts to include some of these species in the concept might become more profitable.

As a practical matter, then, there are about 200 to 250 "discretionary species" left from which to make planting and landscape selections. These species are rated 4 to 8 on the Swink and Wilhelm scale. The annuals and biennials are listed in Table 15 (see Appendix); the perennials in Table 16 (see Appendix); and the woody plants in Table 17 (see Appendix).

Plants not native to the Chicago region are far less desirable than those which are, though unless their rating is negative they can be viewed at least as not counterproductive. Plants with negative ratings are generally considered as counterproductive when they appear in areas where healthy, stable, floristically diverse systems are being encouraged or established. Introduced species are included only in Table 13 inasmuch as Swink and Wilhelm assigned none of them with a rating higher than +3.

Even from among the plants listed in Tables 11, 12 and 13, only some will be practical choices for planting and landscape embellishment. It is not clear

at this time which ones would be the most reasonable selections but factors to consider in analyzing the potential of each species include the following points:

1. The lower the rating coefficient, the more likely the plant will volunteer. Obviously, this is a conceptual spectrum (with ratings from -3 to +20) of plant responsiveness to disturbed soil conditions. Rarely in life does anything ever break simply into easy categories, and the attempt at a trichotomy here is not an exception. It should be viewed as a practical guide, and not as an unequivocal solution to a problem.
2. All other things being equal, the lower the rating the more likely is a successful planting of a given species.
3. The overall mean rating of the revegetation effort depends on there being healthy populations of numerous highly rated species (those with rating coefficients of 6,7 and 8).
4. The availability of large populations of seed-producing plants locally, (within 50 miles of the study area) is important.
5. In the initial phases of revegetation, annuals and biennials are more likely to be successful than perennials -- at least as a general rule. The latter will be most successful in the later phases.
6. Unusually high water during the first years of planting could be discouraging, but the possibility should prepare the attempt with patience.
7. Matching the soil moisture condition to the known tolerances of each plant is critical if seed is not to be wasted.

8. Plant diversity in most prairie wetlands in the Chicago region is enhanced by fire, so the planting of rhizomatous or densely tufted graminoid perennials (which generate large amounts of biomass fuel in the fall) is important.

9. Every effort should be made to discourage reed canary grass in the revegetation process. Regular burning will be particularly helpful in this regard.

10. A high diversity of different kinds of species (at least 40 species per acre) is the most desirable goal. Efforts to achieve this will simultaneously enhance the mean rating coefficient of the wetland.

11. Very coarse herbs, shrubs, and trees planted here and there along slough borders and marsh edges will provide cover and a sense of safety and territorial well-being for numerous wildlife species.

ANIMALS

Unlike the site inventory of vegetation, no site-specific evaluation of wildlife populations was made or available. Several of the tables referred to in Chapter III (Tables 7 - 12, see Appendix) list wildlife species that might be expected in the site because they are known in the Des Plaines Valley. For the conceptual plan, therefore, no more can be said than that, although no reintroduction of wildlife is planned, natural in-migration can be expected to produce a greater diversity of wildlife species at the site. As was noted above, there will be no attempt to create a game wildlife habitat because diversity is the keynote of the plan. An increase in muskrat, beaver, mink and other water-related animals can be anticipated as well as more diverse reptilian and fish populations.

It is perhaps in the aquatic habitats that most change can be expected and particularly among fish populations. Firstly, the changes in water quality will provide conditions suitable for more and healthier fish populations and secondly, the connection of two of the lakes to the riverine system will greatly increase the types of fish habitats. Maintaining the deep lakes will provide winter refuges, and the braided channel areas and aquatic shelves will provide spawning grounds in the warmer seasons.

PUBLIC ACCESS AND USE

It is anticipated that the improved aesthetics of the site and the improved habitat will increase the public's use of the area; indeed this is one of the central perceived benefits of the wetland restoration. Facilities to assist greater public use are, therefore, a component of the conceptual plan and are indicated in Figure 7.

All the features of access presently at the site will remain -- the Wadsworth Road parking lot and fishing dock, and the trail circulating in the northern section of the site with its bridge across the Des Plaines. Further, the northern half of the site will continue to be the most accessible area, with the southern portion remaining more remote.

The major new feature of access in the conceptual plan is a new parking area on Town Line Road (McCarthy Road) which would accomodate fifty cars and two buses. This will bring trail users to the trails on either side of the river and allow easier access to the southern area. It is also hoped that such a facility will eliminate illegal parking along Route 41. The existing trail's location is changed only in one area and moved to the west of the northern-

most gravel pit lake; however, no new crossings of the river are planned. The trail will form the lip of the river terrace, dividing the marshy floodway from the terrace.

Canoe facilities are particularly enhanced. A new canoe launch is proposed at the site of the present day confluence of Mill Creek with the main channel of the Des Plaines, which will be developed and maintained as a conoe trail. At the present time, the reaches of the river to the north of Wadsworth Road are actively used for canoeing; the addition of such facilities in the site area means that a much greater use of the river can be expected.

The wetland restoration will be a demonstration site. As such it will afford the opportunity for education. The improved habitat will make the area suitable for a nature study. The restoration and the ongoing site monitoring will provide interpretive material for all levels of enquiry.

CONSTRUCTION CONSIDERATIONS

The stages of construction for the wetland restoration will take place over one or two years and will be begun at the southern end of the site, working back upstream. The river would either continue to flow in its original channel or, in the instances of the pump placements, would be diverted around the work area. The following order of construction stages is prescribed:

1. Removal and storage of topsoil from the areas to be altered
2. Removal of substrate from the floodway area to the level specified
3. Construction of the braided channel and renovation of the main channel which is at the lowest level to maintain constant flow
4. Construction of aquatic shelves

5. Leveling and construction of wetland terrace and lip; gated return-flows for the irrigation system constructed at various points along the lip

6. Installation of irrigation system's pumps and pipes

7. Replacement of soil

8. Installation of visitor access areas and monitoring system

9. Revegetation process begun. It is likely that this will continue over a period of four to five years, introducing greater plant diversity with time. The process will begin only at the completion of construction.

MANAGEMENT AND OPERATION

One of the expectations of the completed wetland restoration is that management and operation demands will be relatively low, particularly when compared to the multiple benefits that the scheme can afford: improved water quality, flood storage, habitat improvement and recreational benefits. An added benefit of the system is that it will be virtually self-perpetuating and self-maintaining and should require little more management than a well-used recreation area. There are, however, several specific management requirements.

The pumping of water from the river up to the irrigated river terraces will not be a continuous or regular event. The moisture needs of the terrace will depend upon the weather (precipitation and temperature) and upon the flow of the river. At times of high flows, the pumping will be necessary to a minor extent to alleviate the flood hazard and to put the river terrace flood storage capacity into action. At times of low flow, pumping may be shut down to maintain a base flow in the main channel of the Des Plaines

River. The pumps themselves and the gated return flows in the lip of the terrace will have to be maintained and the latter kept free from debris. The gates, like the pumps, will require regulation and will be open and closed depending on the moisture needs of the terrace and the river's flow.

Management of the vegetation is not anticipated to be extensive although the details of this will not be known until species selection is complete and some of the competition and dominance dangers are hypothesized. In the final analysis, much of this knowledge will not be obtained until the restoration is proceeding and the plants are in place. As was noted above, prescribed burning is a management technique that will be introduced as soon as possible as a maintenance tool against invasion of detrimental weeds. The selective burns will be an annual event. As the vegetation develops, woody vegetation may have to be cleared should it encroach on the river's main channel.

Recreation management will have to be increased only to the extent that more users require more surveillance. However, the area is not intended as an intensive recreation area. The Forest Preserve District may wish to develop an interpretive program to explain the features of the site but even this could be a self-guiding system. The river's use as a canoe trail will require regular clearing of snags from the channel.

Finally, because this wetland restoration is the first of such experiments, a monitoring program will be installed. This will assess changes in water quality, wildlife diversity and population, plant communities and recreational use. This important monitoring program will impose extra management burdens but may be most appropriately divided among a number of agencies in a cooperative plan.

ECONOMIC EVALUATION

Of the two components of an economic evaluation, benefits and costs, the benefits of the wetlands project are the most difficult to quantify. They include improved wildlife habitat, water quality enhancement, flood control and more enjoyable recreation. While there are a number of techniques to determine recreational benefits, the other benefits are less tangible.

Looking at one category of benefit, water quality enhancement, the wetland concept can be compared to the alternative of conventional wastewater treatment. These two management strategies are not really comparable in terms of benefits, since wetlands provide for habitat, recreation and flood storage in addition to cleaner water, which is the single benefit provided by conventional treatment. A cost comparison of these two strategies however, does illustrate the substantial difference in the required investments.

Four major cost components must be considered in a comparison of the two alternatives: land acquisiton, construction, pumping, and maintenance and operation. In this evaluation land acquisition costs are not considered for either the conventional or wetland options. The land at the project site is in public ownership. If land were a factor it would substantially increase the costs of the wetland option. In northeastern Illinois, however, large tracts of floodplain land are in public ownership or are being considered for public acquisition. Since wetland creation would not replace another economic use of these properties, land cost need not be considered.

In making the cost comparison, construction costs were converted to annualized costs (Northeastern Illinois Planning Commission, 1977). It was assumed that pumping and conventional treatment facilities had a useful life of 20 years, while the relandscaped topography of the wetland would have a useful life of 100 years. A discount rate of 7 and 7/8, as recommended by the Water Resources Council, was used. Local labor costs with overhead were assumed to be $43,000 per person year (U.S. Environmental Protection Agency, 1978, 1980). A unit cost of $10,000 per acre foot (U.S. Soil Conservation Service, 1981) was assumed for the earth moving and relandscaping required by wetland reconstruction. All cost estimates are for 1981.

The costs of four treatment options are summarized in Tables 18 and 19: conventional treatment and three wetland treatment options. Each option represents a mix of production factors that would allow the treatment of 25 cubic feet per second. This would result in approximately 20 percent of the mean annual flow being treated -- high flows as well as part of the low flow would be by-passed through the modified channel.

The conventional treatment option is made up of the following stages:

1. Raw wastewater screening and pumping
2. Primary sedimentation
3. Biological nitritation
4. Biological denitrification
5. Filtration
6. Sludge handling

The costs were divided into construction and operating costs. Pumping and

treatment costs were identified separately within each category, to allow pumping costs to be compared with the equivalent costs for the wetlands options.

Table 18: Comparison of Capital Costs of Construction

	Conventional Treatment	Wetland Treatment		
		Option 1	Option 2	Option 3
Pumping	490,000	490,000	490,000	490,000
Structures	16,000,000			
Landscaping	-	5,100,000	10,000,000	8,000,000
TOTAL	16,490,000	5,590,000	10,490,000	8,490,000

Table 19: Annualized Cost Comparison Between Conventional Wastewater Treatment and Wetland Treatment

	CONVENTIONAL TREATMENT		WETLAND TREATMENT					
			Option #1		Option #2		Option #3	
	Construction	Operating	Construction	Operating	Construction	Operating	Construction	Operating
Pumping	$ 49,000	$ 56,000	$ 49,000	$ 51,000	$ 49,000	$ 51,000	$ 49,000	$ 51,000
Treatment	1,600,000	950,000						
Land Management			400,000	800,000	800,000	400,000	630,000	300,000
Total	1,600,000	1,000,000	450,000	850,000	850,000	450,000	680,000	350,000
GRAND TOTAL	$2,600,000		$1,300,000		$1,300,000		$1,000,000	

The three wetland options were selected to demonstrate alternative mixes of project elements that could produce water quality benefits equivalent to those produced by the conventional treatment, at substantial cost savings. Size of maintenance staff and amount of flood storage area (i.e. excavation) varies for each option. Pumping costs for all options

remain the same as for conventional treatment. The wetland options considered were:

1. Half the annualized costs of conventional treatment: using the same size staff as required for conventional treatment.
2. Half the annualized costs of conventional treatment: using one-half the staff required for conventional treatment.
3. One-third the annualized costs of conventional treatment: using minimum staff.

The first option assumed a 15-person labor force to maintain and operate the wetlands. This would include not only groundskeepers but also personnel to operate the pumps, collect field data for laboratory analysis, and manage the wetlands and stream channels to maximize the beneficial return. This option would provide 510 more acre feet of floodplain storage than exists on the site today.

In the second option the labor force would be reduced to approximately 8 persons. This option leaves approximately ten million dollars for landscaping, which results in the creation of 1,000 acre feet of floodplain storage.

The third option assumes a staff of 6 and creates approximately 800 acre feet of floodplain storage.

Although energy costs are not calculated here, it should be noted that the only energy required to operate the wetlands options would be for pumping, while the energy requirements to operate a conventional treatment plant are greater.

In summary, whichever wetland option is chosen, it would provide benefits beyond the water quality benefits derived from conventional treatment at considerably less cost. The wetland recreation project could easily be staged to create additional floodplain storage and wetland terraces as money became available, at the same time providing benefits from the completion of the first unit. The entire wetland area need not be constructed at one time.

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APPENDICES

Table 3: Vegetation Found Along the Des Plaines River Banks at the Project Site

Rating Coefficient	Species
0	Acer negundo BOXELDER
0	Acer saccharinum SILVER MAPLE
-3	Alliaria officinalis GARLIC MUSTARD
0	Ambrosia trifida GIANT RAGWEED
-3	Arctium minus COMMON BURDOCK
1	Aster pilosus HAIRY ASTER
2	Aster sagittifolius drummondii DRUMMOND'S ASTER
1	Barbarea vulgaris YELLOW ROCKET
1	Carex laxiflora WOOD SEDGE
4	Elymus virginicus VIRGINIA WILD RYE
1	Festuca elatior COMMON FESCUE
2	Fraxinus pennsylvanica subintegerrima GREEN ASH
1	Galium aparine COMMON BEDSTRAW
0	Geum canadense WHITE AVENS
3	Impatiens capensis TOUCH-ME-NOT
2	Lactuca canadensis WILD LETTUCE
-1	Leonurus cardiaca MOTHERWORT
4	Lysimachia ciliata FRINGED LOOSESTRIFE
0	Oxalis stricta COMMON WOOD SORREL
0	Poa pratensis KENTUCKY BLUE GRASS
2	Populus deltoides COTTONWOOD
1	Prunus serotina WILD BLACK CHERRY
0	Ranunculus abortivus SMALL-FLOWERED BUTTERCUP
-3	Rosa multiflora MULTIFLORA ROSE
-1	Rumex crispus CURLY DOCK
0	Salix fragilis CRACK WILLOW
1	Salix interior SANDBAR WILLOW
1	Sambucus canadensis ELDERBERRY
-3	Solanum dulcamera BITTERSWEET NIGHTSHADE
3	Ulmus americana AMERICAN ELM

Autecological rating as given by Swink and Wilhelm (1979).

Table 4: Plants found in the Woodland Areas at the Project Site

Rating Coefficient	Species
0	Acer negundo BOXELDER
5	Acer nigrum BLACK MAPLE
0	Acer saccharinum SILVER MAPLE
5	Acer saccharum SUGAR MAPLE
2	Agrimonia gryposepala TALL AGRIMONY
1	Allium canadense WILD ONION
6	Allium tricoccum burdickii WILD LEEK
4	Anemone canadensis MEADOW ANEMONE
7	Anemone quinquefolia interior WOOD ANEMONE
5	Arisaema atrorubens JACK-IN-THE-PULPIT
8	Arisaema dracontium GREEN DRAGON
2	Aster sagittifolius drummondii DRUMMOND'S ASTER
2	Carex amphibola turgida GRAY SEDGE
1	Carex laxiflora WOOD SEDGE
1	Carex rosea FOUNTAIN WOOD SEDGE
7	Carya cordiformis BITTERNUT HICKORY
5	Carya ovata SHAGBARK HICKORY
8	Caulophyllum thalictroides BLUE COHOSH
0	Circaea quadrisulcata canadensis ENCHANTER'S NIGHTSHADE
2	Claytonia virginica SPRING BEAUTY
5	Cornus obliqua BLUE-FRUITED DOGWOOD
1	Cornus racemosa GRAY DOGWOOD
6	Cornus stolonifera RED-OSIER DOGWOOD
0	Cryptotaenia canadensis HONEWORT
5	Dentaria laciniata TOOTHWORT
4	Erigeron philadelphicus MARSH FLEABANE
5	Erythronium albidum WHITE TROUT LILY
1	Fragaria virginiana WILD STRAWBERRY
5	Fraxinus americana WHITE ASH
7	Fraxinus pennsylvanica RED ASH
2	Fraxinus pennsylvanica subintegerrima GREEN ASH
1	Galium aparine COMMON BEDSTRAW
4	Galium concinnum SHINING BEDSTRAW
5	Galium triflorum SWEET-SCENTED BEDSTRAW
4	Geranium maculatum WILD GERANIUM
0	Geum canadense WHITE AVENS
1	Geum laciniatum trichocarpum ROUGH AVENS
5	Hydrophyllum virginianum VIRGINIA WATERLEAF
3	Impatiens capensis TOUCH-ME-NOT
8	Isopyrum biternatum FALSE RUE ANEMONE
5	Juglans nigra BLACK WALNUT
4	Lysimachia ciliata FRINGED LOOSESTRIFE
7	Lonicera prolifera YELLOW HONEYSUCKLE
6	Menispermum canadense MOONSEED
3	Parthenocissus quinquefolia VIRGINIA CREEPER
5	Phlox divaricata WOODLAND PHLOX

Autecological rating as given by Swink and Wilhelm (1979).

Table 4, continued (page 2 of 2)

Rating Coefficient	Species
5	Pilea pumila CLEARWEED
5	Podophyllum peltatum MAYAPPLE
5	Polygonatum canaliculatum SOLOMON'S SEAL
2	Populus deltoides COTTONWOOD
1	Prunus serotina WILD BLACK CHERRY
1	Prunus virginiana CHOKE CHERRY
4	Quercus alba WHITE OAK
8	Quercus bicolor SWAMP WHITE OAK
4	Quercus ellipsoidalis HILL'S OAK
4	Quercus macrocarpa BUR OAK
7	Quercus rubra RED OAK
0	Ranunculus abortivus SMALL-FLOWERED BUTTERCUP
4	Ranunculus septentrionalis SWAMP BUTTERCUP
1	Rhus radicans POISON IVY
7	Ribes americanum WILD BLACK CURRANT
5	Ribes missouriensis WILD GOOSEBERRY
3	Rubus allegheniensis COMMON BLACKBERRY
2	Rubus occidentalis BLACK RASPBERRY
3	Rudbeckia laciniata WILD GOLDEN GLOW
1	Sambucus canadensis ELDERBERRY
2	Sanicula gregaria BLACK SNAKEROOT
2	Smilacina racemosa FEATHERY FALSE SOLOMON'sSEAL
3	Smilax ecirrhata UPRIGHT CARRION FLOWER
4	Smilax lasioneura COMMON CARRION FLOWER
5	Thalictrum dasycarpum hypoglaucum PURPLE MEADOW RUE
5	Tahlictrum dioicum EARLY MEADOW RUE
5	Tilia americana BASSWOOD
6	Trillium flexipes DECLINED TRILLIUM
5	Trillium recurvatum RED TRILLIUM
3	Ulmus americana AMERICAN ELM
4	Ulmus rubra SLIPPERY ELM
2	Urtica procera TALL NETTLE
5	Viburnum lentago NANNYBERRY
0	Viola papilionacea COMMON BLUE VIOLET
5	Viola pensylvanica SMOOTH YELLOW VIOLET
4	Vitis riparia RIVERBANK GRAPE

Autecological rating as given by Swink and Wilhelm (1979).

Table 5: Plants Found in the Study Site (excluding the woodland areas)

Rating Coefficient	Species
0	Acer negundo BOXELDER
0	Acer saccharinum SILVER MAPLE
0	Acnida altissima WATER HEMP
4	Alisma triviale LARGE-FLOWERED WATER PLANTAIN
0	Ambrosia artemisiifolia elatior COMMON RAGWEED
0	Ambrosia trifida GIANT RAGWEED
2	Anemone cylindrica THIMBLEWEED
6	Apios americana GROUND NUT
2	Apocynum sibiricum INDIAN HEMP
-3	Arctium minus COMMON BURDOCK
4	Asclepias incarnata SWAMP MILKWEED
0	Asclepias syriaca COMMON MILKWEED
4	Aster novae-angliae NEW ENGLAND ASTER
1	Aster pilosus HAIRY ASTER
2	Aster sagittifolius drummondii DRUMMOND'S ASTER
3	Aster simplex PANICLED ASTER
10	Aster umbellatus FLAT-TOP ASTER
1	Barbarea vulgaris YELLOW ROCKET
5	Bidens cernua NODDING BUR MARIGOLD
1	Bidens frondosa COMMON BEGGAR'S TICKS
-1	Brassica kaber pinnatifida CHARLOCK
-1	Brassica nigra BLACK MUSTARD
-1	Bromus inermis HUNGARIAN BROME
0	Bromus japonicus JAPANESE CHESS
0	Bromus tectorum DOWNY BROME
3	Calamagrostis canadensis BLUE JOINT GRASS
0	Capsella bursa-pastoris SHEPHERD'S PURSE
-2	Carduus nutans NODDING THISTLE
5	Carex aquatilis altior BLUE MEADOW SEDGE
3	Carex brevior SHORTER PRAIRIE SEDGE
3	Carex gravida HEAVY SEDGE
10	Carex lacustris LAKE SEDGE
4	Carex lanuginosa WOOLLY SEDGE
2	Carex stipata SOFT-STEMMED SEDGE
5	Carex stricta MEADOW SEDGE
1	Cerastium vulgatum MOUSE-EAR CHICKWEED
1	Chenopodium album LAMB'S QUARTERS
1	Cichorium intybus CHICKORY
-3	Cirsium arvense FIELD THISTLE
-3	Cirsium vulgare BULL THISTLE
2	Claytonia virginica SPRING BEAUTY
1	Cornus racemosa GREY DOGWOOD
5	Crataegus calpodendron SUGAR HAWTHORN
1	Crataegus crus-galli COCKSPUR HAWTHORN
2	Crataegus mollis DOWNY HAWTHORN
6	Crataegus pruinosa FROSTED HAWTHORN

Autecological rating as given by Swink and Wilhelm (1979).

Table 5, continued (page 2 of 4)

Rating Coefficient	Species
1	Crategus punctata DOTTED HAWTHORN
1	Cyperus esculentus CHUFA
1	Cyperus strigosus FALSE CHUFA
1	Dactylis glomerata ORCHARD GRASS
1	Daucus carota QUEEN ANNE'S LACE
6	Dodecatheon meadia SHOOTING STAR
0	Echinochloa crusgalli BARNYARD GRASS
4	Elymus virginicus VIRGINIA WILD RYE
3	Epilobium coloratum CINNAMON WILLOW HERB
0	Equisetum arvense HORSETAIL
3	Equisetum hyemale intermedium SMOOTH SCOURING RUSH
1	Erigeron annuus ANNUAL FLEABANE
0	Erigeron canadensis HORSEWEED
6	Eupatorium perfoliatum BONESET
1	Festuca elatior COMMON FESCUE
1	Fragaria virginiana WILD STRAWBERRY
2	Fraxinus pennsylvanica subintegerrima GREEN ASH
1	Galium aparine COMMON BEDSTRAW
2	Gaura biennis BIENNIAL GAURA
0	Geum canadense WHITE AVENS
-1	Glechoma hederacea CREEPING CHARLIE
2	Helianthus grosseserratus SAW-TOOTH SUNFLOWER
3	Helianthus tuberosus JERUSALEM ARTICHOKE
1	Hemerocallis fulva ORANGE DAY LILY
5	Heracleum maximum COW PARSNIP
3	Impatiens capensis TOUCH-ME-NOT
5	Iris virginica shrevei BLUE FLAG
4	Juncus dudleyi DUDLEY'S RUSH
2	Juniperus virginiana crebra RED CEDAR
2	Lactuca canadensis WILD LETTUCE
-1	Lactuca scariola PRICKLY LETTUCE
5	Leersia oryzoides RICE CUT GRASS
5	Limna minor SMALL DUCKWEED
-1	Leonurus cardiaca MOTHERWORT
0	Lepidium campestre FIELD CRESS
0	Lepidium virginicum COMMON PEPPERCRESS
6	Lilium michiganense MICHIGAN LILY
-1	Linaria vulgaris BUTTER-AND-EGGS
7	Lobelia cardinalis CARDINAL FLOWER
6	Lobelia siphilitica GREAT BLUE LOBELIA
-3	Lonicera X bella TARTARIAN HONEYSUCKLE
-2	Lychnis alba WHITE CAMPION
5	Lycopus americanus COMMON WATER HOREHOUND
4	Lysimachia ciliata FRINGED LOOSESTRIFE
-1	Lysimachia nummularia MONEYWORT
0	Medicago lupulina BLACK MEDIC
-3	Melilotus alba WHITE SWEET CLOVER

[1] Autecological rating as given by Swink and Wilhelm (1979)

Rating Coefficient	Species
-2	Melilotus officinalis YELLOW SWEET CLOVER
4	Monarda fistulosa WILD BERGAMOT
-1	Morus alba WHITE MULBERRY
-1	Napeta cataria CATNIP
1	Oenothera biennis COMMON EVENING PRIMROSE
0	Oxalis stricta COMMON WOOD SORREL
1	Panicum capillare OLD WITCH GRASS
3	Panicum implicatum WOOLlY PANIC GRASS
0	Phalaris arundinacea REED CANARY GRASS
5	Physostegia virginiana FALSE DRAGONHEAD
0	Plantago major COMMON PLANTAIN
0	Plantago rugelii RED-STALKED PLANTAIN
1	Poa annua ANNUAL BLUE GRASS
0	Poa compressa CANADA BLUE GRASS
0	Poa pratensis KENTUCKY BLUE GRASS
0	Polygonum pensylvanicum laevigatum PENNSYLVANIA KNOTWEED
0	Potentilla norvegica NORWAY CINQUEFOIL
1	Potentilla recta SULFUR CINQUEFOIL
1	Prunus serotina WILD BLACK CHERRY
1	Prunus virginiana CHOKE CHERRY
5	Pycnanthemum virginianum MOUNTAIN MINT
2	Pyrus ioensis IOWA CRAB
1	Pyrus malus APPLE
4	Quercus ellipsoidalis HILL'S OAK
4	Quercus macrocarpa BUR OAK
0	Ranunculus abortivus SMALL-FLOWERED BUTTERCUP
-3	Rhamnus cathartica COMMON BUCKTHORN
1	Rhus glabra SMOOTH SUMAC
5	Rosa blanda EARLY WILD ROSE
-3	Rosa multiflora MULTIFLORA ROSE
2	Rubus occidentalis BLACK RASPBERRY
2	Rumex altissimus PALE DOCK
-1	Rumex crispus CURLY DOCK
0	Salix fragilis CRACK WILLOW
1	Salix interior SANDBAR WILLOW
4	Salix nigra BLACK WILLOW
5	Salix rigida HEART-LEAVED WILLOW
1	Sambucus canadensis ELDERBERRY
6	Scirpus cyperinus WOOL GRASS
6	Scirpus fluviatilis RIVER BULRUSH
5	Scutellaria lateriflora MAD-DOG SKULLCAP
6	Senecio pauperculus balsamitae BALSAM RAGWORT
7	Sium suave WATER PARSNIP
-2	Solanum carolinense HORSE NETTLE

Autecological rating as given by Swink and Wilhelm (1979)

Table 5, continued (page 4 of 4)

Rating Coefficient	Species
1	Solidago altissima TALL GOLDENROD
3	Solidago gigantea leiophylla LATE GOLDENROD
3	Solidago graminifolia nuttallii GRASS-LEAVED GOLDENROD
-1	Sonchus asper SPINY SOW THISTLE
-2	Sonchus uliginosus COMMON SOW THISTLE
5	Spartina pectinata PRAIRIE CORD GRASS
7	Spiraea alba MEADOW SWEET
0	Taraxacum officinale DANDELION
1	Trifolium hybridum ALSIKE CLOVER
1	Trifolium repens WHITE CLOVER
2	Typha angustifolia NARROW-LEAVED CATTAIL
1	Typha latifolia BROAD-LEAVED CATTAIL
3	Ulmus americana AMERICAN ELM
4	Ulmus rubra SLIPPERY ELM
2	Urtica procera TALL NETTLE
1	Verbascum blattaria MOTH MULLEIN
1	Verbascum thapsus COMMON MULLEIN
4	Verbena hastata BLUE VERVAIN
5	Vernonia fasciculata COMMON IRONWEED
1	Veronica peregrina PURSELANE SPEEDWELL
6	Veronicastrum virginicum CULVER'S ROOT
7	Vicia americana AMERICAN VETCH
4	Vitis riparia RIVERBANK GRAPE

Autecological rating as given by Swink and Wilhelm (1979)

Table 6: Fish Found in the Gravel Pit Lakes at the Project Site (Percent of Total Yield by Species)

Species	Northern Pit	Middle Pit	Southern Pit
Amia calva BOWFIN	2		
Umbra limi CENTRAL MUD MINNOW			2
Esox lucius NORTHERN PIKE	2		
Cyprinus carpio CARP	36	38	6
Notemigonus crysoleucas GOLDEN SHINER		3	2
Catostomus commersoni WHITE SUCKER			2
Minytrema melanopos SPOTTED SUCKER	2		
Ictalurus melas BLACK BULLHEAD		2	
Roccus mississippiensis YELLOW BASS		8	
Lepomis cyanellus GREEN SUNFISH	2		
Lepomis gibbosus PUMPKINSEED	6	2	
Lepomis macrochirus NORTHERN BLUEGILL	28	36	44
Micropterus salmoides NORTHERN LARGEMOUTH BASS	10	7	30
Pomoxis annularis WHITE CRAPPIE	2		
Pomoxis nigromaculatus BLACK CRAPPIE	12	5	13
Perca flavescens YELLOW PERCH		*	

* Reported by Laurie (1981b)

Table 7: Fish Recorded in the Des Plaines River and its Tributary Mill Creek

[1]

Esox americanus vermiculatus	GRASS PICKEREL
*Esox lucius	NORTHERN PIKE
Carassius auratus	GOLDFISH
Cyprinus carpio	CARP
Hybopsis biguttata	HORNEYHEAD CHUB
*Notemigonus crysoleucas	GOLDEN SHINER
Notropis anogenus	PUGNOSE SHINER
Notropis atherinoides	EMERALD SHINER
*Notropis cornutus	COMMON SHINER
Notropis spilopteris	SPOTFIN SHINER
Notropis umbratilis	REDFIN SHINER
*Pimephales notatus	BLUNTNOSE MINNOW
Pimephales promelas	NORTHERN FATHEAD MINNOW
Catostomus commersoni	WHITE SUCKER
Minytrema melanops	SPOTTED SUCKER
Moxostoma sp.	REDHORSE
Ictalurus melas	BLACK BULLHEAD
Ictalurus natalis	YELLOW BULLHEAD
Ictalurus punctatus	CHANNEL CATFISH
Noturus gyrinus	TADPOLE MADTOM
Roccus mississippiensis	YELLOW BASS
Ambloplites rupestris	ROCK BASS
Lepomis cyanellus	GREEN SUNFISH
Lepomis gibbosus	PUMPKINSEED
*Lepomis macrochirus	NORTHERN BLUEGILL
Micropterus dolomieui	SMALLMOUTH BASS
*Micropterus salmoides	NORTHERN LARGEMOUTH BASS
*Pomoxis nigromaculatus	BLACK CRAPPIE
Etheostoma nigrum	JOHNNY DARTER
Percina maculata	BLACKSIDE DARTER

[1] Reported by Laurie (1981b)

* Reported only in Mill Creek

Table 8: Benthic Organisms Recorded at the Project Site (organisms as a percentage of sample).

	TOLERANCE	JUNE	SEPT	DEC	MARCH	AVE.
Total Individuals per m^2		1875	5277	7544	10335	6258
Diptera (TRUE FLIES)						
Chironomidae	T	2	11	27	60	35
Trichoptera (CADDIS FLIES)						
Leptoceridae	I	2	-	-	-	t
Ephemeroptera (MAYFLIES)						
Baetisca laurentiana		2	-	-	-	t
Hexagenia limbata	F	-	-	t	-	t
Ephemeroptera sp.	F	-	-	-	t	t
Hemiptera (TRUE BUGS)						
Corixidae	F	-	3	-	-	1
Coleoptera (BEETLES)						
Coleoptera sp.		-	-	-	t	t
Annelida (SEGMENTED WORMS)						
Oligochaeta	T,F	86	72	73	34	59
Gastropoda (SNAILS)						
Planorbidae	T,F,I	5	1	-	1	1
Amnicolidae	T,F,I	2	-	-	-	t
Valvata	F,I	-	1	-	-	t
Physidae	T,F,I	-	-	-	t	t
Viviparidae	F,I	-	4	-	3	2
Decopoda (CRAYFISH)						
Astacinae	T,F,I	-	1	-	-	t

T - tolerant
F - facultative
I - intolerant

With respect to high decomposable biomass concentrations

t - trace

Source: Des Plaines River Aquatic Study, 1978.

Table 9: Zooplankton of the Project Site

Species	% Taxon Composition	% Sample
Cladocera		42
Alona guttata	t	
Alona sp.	t	
Bosmina longirostris	90	
Cerodaphnia sp.	t	
Daphnia laevis	2	
Daphnia longiremis	t	
Daphnia pulex	t	
Daphnia sp.	1	
Cladocera (immature)	6	
Moina macrocopa	t	
Macrothricidae sp.	t	
Macrothrix rosea	t	
Pleuroxus denticulatus	t	
Copepoda		32
Cyclopoda (indet.)	9	
Cyclops sp.	t	
Diaptomidae (indet.)	1	
Ergasilidae	4	
Harpacticoida	1	
Nauplii (indet.)	85	
Parcyclops denticulatus	t	
Rotifera		26
Brachionus angularis	3	
Brachionus calyciflorus	2	
Brachionus caudalis	8	
Brachionus plicatilis	25	
Brachionus quadridentata	13	
Brachionus sp.	t	
Filinia longiseta	1	
Euchlanis sp.	t	
Keratella cochlearis	4	
Keratella hiemalis	4	
Keratella quadrata	1	
Lecane luna	t	
Lepadella sp.	t	
Notholca sp.	t	
Platyias patulus	2	
Polyartha sp.	31	
Rotifera (indet.)	7	

Data gathered June, 1975 to March, 1976

able 10: Amphibians and Reptiles of the Des Plaines River Valley in Lake County

pecies	Habitat
mblystoma laterale BLUE SPOTTED SALAMANDER	wooded swampy areas
ufo americanus AMERICAN TOAD	ubiquitous
cris crepitans blanchardii BLANCHARD'S CRICKET FROG	ubiquitous in wet places
seudacris triseriata WESTERN CHORUS FROG	floodplains and mesic woods
yla crucifer NORTHERN SPRING PEEPER	mesic woodlands and woodland pools
yla versicolor EASTERN GRAY TREEFROG	woodlands
ana catesbeiana BULLFROG	permanent water
ana clamitans melanota GREEN FROG	aquatic habitats
ana palustris PICKERAL FROG	ponds, creeks, marshes
ana pipiens LEOPARD FROG	streams and ponds
helydra serpentina COMMON SNAPPING TURTLE	ponds and streams
mydoidea blandingi BLANDING'S TURTLE	ponds and floodplain sloughs
hrysemys picta marginata MIDLAND PAINTED TURTLE	aquatic to terrestrial
hrysemys picta belli WESTERN PAINTED TURTLE	aquatic to terrestrial
rionyx spinifer EASTERN SPINY SOFTSHELL	streams and sloughs
hamnophis radix EASTERN PLAINS GARTER SNAKE	meadows and pastures near villages
toreria dekayi wrightorum MIDLAND BROWN SNAKE	debris, vacant lots, forest edge, etc.
istrurus catenatus EASTERN MASSASAUGA	prairie marshes

st compiled by the Lake County Forest Preserve District
omenclature, common names, and habitat notes are from Smith (1971)

Table 11: Mammals of the Des Plaines River Valley in Lake County

Species	Habitat
Didelphis virginiana OPOSSUM	prefers farmed areas, usually nocturnal
Sorex cinereus MASKED SHREW	prefers moist situations
Blarina brevicauda SHORTTAIL SHREW	ubiquitous in terrestrial situations
Lasiurus borealis RED BAT	wooded areas, usually in old trees
Procyon lotor RACCOON	wooded areas near water
Mustela frenata LONGTAIL WEASEL	ubiquitous in terrestrial habitats
Mustela vison MINK	streams and lakes
Mephitis mephitis STRIPED SKUNK	ubiquitous in terrestrial habitats
Urocyon cinereoargenteus GRAY FOX	brushy and wooded areas
Vulpes fulva Red fox	brushy and wooded areas
Marmota monax WOODCHUCK	woodland edges, fields and meadows
Citellus tridecemlineatus THIRTEEN-LINED GROUND SQUIRREL	fields, meadows, open woods
Citellus franklini FRANKLIN'S GROUND SQUIRREL	fields, meadows, open woods
Tamias striatus EASTERN CHIPMUNK	wooded and brushy areas
Sciurus carolinensis EASTERN GRAY SQUIRREL	wooded areas
Sciurus niger EASTERN FOX SQUIRREL	oak-hickory woodlands
Glaucomys volans SOUTHERN FLYING SQUIRREL	woodlands
Peromyscus leucopus WHITE-FOOTED MOUSE	wooded or brushy areas
Microtus pennsylvanicus MEADOW VOLE	fields, meadows, open woods
Ondatra zibethica MUSKRAT	marshes and sloughs
Zapus hudsonius MEADOW JUMPING MOUSE	meadows, fields, open woods
Sylvilagus floridanus EASTERN COTTONTAIL	woodlots and brushy areas
Odocoileus virginianus WHITETAIL DEER	wooded areas

List compiled by the Lake County Forest Preserve District
Nomenclature and common names are those employed by Burt and Grossenheider (1952)

Table 12: Birds Observed at the Project Site and Birds of the Region Likely to be Found at the Project Site

Pied-billed grebe
§Great blue heron
*§Green heron
Black crowned night heron
§American bittern
* Canada goose
*§Mallard
Black duck
Green-winged teal
*§Blue-winged teal
Baldpate
§Shoveller
*§Wood duck
Lesser scaup duck
Bufflehead
Ruddy duck
§Turkey vulture
*§Red-tailed hawk
* Red-shouldered hawk
Broad-winged hawk
§American rough-legged hawk
Marsh hawk
*§Sparrow hawk
*§Ring-necked pheasant
*§Sora
§Coot
*§Killdeer
§Black-bellied plover
§Semipalmated plover
Spotted sandpiper
§Solitary sandpiper
§Red-backed sandpiper
§Dowitcher
Black tern
* Rock dove
*§Mourning dove
* Yellow-billed cuckoo
*§Black-billed cuckoo
* Screech owl
Whip-poor-will
* Nighthawk
* Chimney swift
* Ruby-throated hummingbird
*§Belted kingfisher
*§Flicker
* Red-bellied woodpecker
* Red-headed woodpecker
§Yellow-bellied sapsucker
* Hairy woodpecker
* Downy woodpecker
* Eastern kingbird
*§Crested flycatcher
* Phoebe
* Wood pewee
Olive-sided flycatcher
Horned lark
§Tree swallow
§Barn swallow
* Purple martin
*§Blue jay
*§Crow
* Black-capped chickadee
* White-breasted nuthatch
*§House wren
Winter wren
* Short-billed marsh wren
*§Catbird
*§Brown thrasher
*§Robin
* Wood thrush
§Hermit thrush
§Olive-backed thrush
* Veery
* Eastern bluebird
Golden-crowned kinglet
§Ruby-crowned kinglet
*§Cedar waxwing
*§Starling
* Yellow-throated vireo
Blue-headed vireo
*§Red-eyed vireo
* Warbling vireo
§Black-and-white warbler
* Prothonotary warbler
Golden-winged warbler
Blue-winged warbler
§Tennessee warbler
Nashville warbler
*§Yellow warbler
§Magnolia warbler
§Cape May warbler
Black-throated blue warbler

* Species which probably nest at the study site
§ Recorded at the study site by the Lake County Forest Preserve District

Table 12, continued (page 2 of 2)

§Myrtle warbler
Black throated green warbler
§Blackburnian warbler
* Chestnut-sided warbler
Bay-breasted warbler
Blackpoll warbler
§Palm warbler
* Ovenbird
§Northern waterthrush
*§Yellow throat
* Yellow-breasted chat
§Wilson's warbler
Canada warbler
*§American redstart
*§House sparrow
* Bobolink
* Eastern meadowlark
*§Western meadowlark
*§Redwing
* Baltimore oriole
Rusty blackbird
*§Bronzed grackle
§Cowbird
* Scarlet tanager
*§Cardinal
* Rose-breasted grosbeak
*§Indigo bunting
* Dickcissel
Purple finch
Redpoll
Pine siskin
*§Common goldfinch
*§Towhee
* Savanna sparrow
* Grasshopper sparrow
* Vesper sparrow
Slate-colored junco
Tree sparrow
*§Chipping sparrow
* Field sparrow
§White-crowned sparrow
White-throated sparrow
Fox sparrow
*§Swamp sparrow
*§Song sparrow

* Species which probably nest at the study site
§ Recorded at the study site by the Lake County Forest Preserve District

Table 13: Vascular Plant Species Most Likely to Volunteer in the Revegetation Process

RC	AQ	PA	MO	A	B	P	W	Plant species
0		X	X				X	Acer negundo BOXELDER
0		X	X				X	Acer saccharinum SILVER MAPLE
0		X	X	X				Acnida altissima WATER HEMP
0		X	X	X				*Alopercurus carolinianus ANNUAL FOXTAIL
0			X			X		Asclepias syriaca COMMON MILKWEED
2			X			X		Aster sagittifolius drummondii DRUMMOND'S ASTER
3		X				X		Aster simplex PANICLED ASTER
1		X	X	X				Bidens frondosa COMMON BEGGAR'S TICKS
1		X	X	X				Bidens vulgata TALL BEGGAR'S TICKS
3			X			X		Boehmeria cylindrica drummondiana FALSE NETTLE
3		X	X			X		Calamagrostis canadensis BLUE JOINT GRASS
2			X			X		Carex amphibola turgida GREY SEDGE
3		X	X			X		Carex bebbiana BEBB'S SEDGE
3			X			X		Carex brevior SHORTER PRAIRIE SEDGE
3		X	X			X		Carex sparganioides BUR REED SEDGE
2		X	X			X		Carex stipata SOFT-STEMMED SEDGE
3		X	X			X		Carex tribuloides CALTROP SEDGE
2		X	X			X		Carex vulpinoidea FOX SEDGE
3			X				X	Celtis occidentalis HACKBERRY
1			X			X		Convolvulus sepium HEDGE BINDWEED
0			X			X		Cryptotaenia canadensis HONEWORT
3			X	X		X		Cyperus erythrorhizos RED-ROOTED SEDGE
1			X			X		Cyperus esculentus CHUFA
2			X	X				Cyperus ferruginescens FRAGILE-FLOWERED SEDGE
1			X	X		X		Cyperus strigosus LEAN SEDGE
0		X	X	X				Echinochloa crusgalli BARNYARD GRASS
2			X	X				Ellisia nyctelea AUNT LUCY
3		X	X			X		Epilobium coloratum CINNAMON WILLOW HERB
3		X	X			X		Epilobium glandulosum adenocaulon NORTHERN WILLOW HERB
1		X				X		*Epilobium hirsutum HAIRY WILLOW HERB
0		X	X			X		Equisetum arvense HORSETAIL
2		X	X	X				Erechtites hieracifolia FIREWEED
2			X				X	Fraxinus pennsylvanica subintegerrima GREEN ASH
2			X		X			Gaura biennis BIENNIAL GAURA
0			X			X		Geum canadense WHITE AVENS
1			X			X		Geum laciniatum trichocarpum ROUGH AVENS
2			X			X		Helianthus grosseserratus SAW-TOOTH SUNFLOWER

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist
A = annual
B = biennial
P = perennial
W = woody
* = non-native species

Table 13, continued (page 2 of 3)

RC	AQ	PA	MO	A	B	P	W	Plant species
3		X				X		Helianthus tuberosus JERUSALEM ARTICHOKE
3		X	X	X				Impatiens capensis SPOTTED TOUCH-ME-NOT
0		X				X		Iris pseudacorus YELLOW IRIS
0		X	X			X		Juncus tenuis ROADSIDE RUSH
2			X		X			Lactuca biennis TALL BLUE LETTUCE
2			X		X			Lactuca canadensis WILD LETTUCE
3			X			X		Laportea canadensis WOOD NETTLE
0			X	X	X			Lepidium virginicum COMMON PEPPER GRASS
2		X				X		*Lycopus asper ROUGH WATER HOREHOUND
-1			X			X		*Lysimachia nummularia MONEYWORT
0			X			X		*Lysimachia vulgaris GARDEN LOOSESTRIFE
1		X				X		*Lythrum salicaria PURPLE LOOSESTRIFE
3			X			X		Muhlenbergia frondosa COMMON SATIN GRASS
2	X	X				X		*Myosotis scorpioides COMMON FORGET-ME-NOT
1			X			X		*Myosoton aquaticum WATER CHICKWEED
2	X	X				X		*Nasturtium officinale WATER CRESS
1			X		X			Oenothera biennis COMMON EVENING PRIMROSE
0			X	X		X		Oxalis europaea TALL WOOD SORREL
0			X			X		Oxalis stricta COMMON WOOD SORREL
1			X	X				Panicum capillare OLD WITCH GRASS
0			X	X				Panicum dichotomiflorum KNEE GRASS
3			X			X		Panicum implicatum COMMON PANIC GRASS
0		X	X			X		Phalaris arundinacea REED CANARY GRASS
2			X			X		Phytolacca americana POKEWEED
2			X	X				Polygonum hydropiper WATER PEPPER
0			X	X				Polygonum lapathifolium HEARTSEASE
0			X	X				Polygonum pensylvanicum laevigatum PENNSYLVANIA KNOTWE
2			X			X		Polygonum scandens CLIMBING FALSE BUCKWHEAT
2			X				X	Populus deltoides COTTONWOOD
2	X					X		*Potamogeton crispus BEGINNER'S PONDWEED
0			X	X				Ranunculus abortivus SMALL-FLOWERED BUTTERCUP
-3		X	X				X	*Rhamnus frangula GLOSSY BUCKTHORN
1		X	X			X		*Rorippa sylvestris CREEPING YELLOW CRESS
1			X			X		Rudbeckia hirta BLACK-EYED SUSAN
3			X			X		Rudbeckia laciniata WILD GOLDEN GLOW
2		X	X			X		Rumex altissimus PALE DOCK

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist
A = annual
B = biennial
P = perennial
W = woody
* = non-native species

ble 13, continued (page 3 of 3)

PA	MO	A	B	P	W	Plant species
	X				X	*Salix alba WHITE WILLOW
X	X				X	Salix discolor PUSSY WILLOW
	X				X	*Salix fragilis CRACK WILLOW
X	X				X	Salix interior SANDBAR WILLOW
	X				X	Sambucus canadensis ELDERBERRY
X	X			X	X	*Solanum dulcamera BITTERSWEET NIGHTSHADE
	X			X		Solidago altissima TALL GOLDENROD
X	X			X		Solidago gigantea LATE GOLDENROD
	X			X		Solidago graminifolia nuttallii DOWNY GOLDENROD
	X			X		Teucrium canadense WOOD SAGE
	X			X		Teucrium occidentale CLAMMY WOOD SAGE
X				X		Typha angustifolia NARROW-LEAVED CATTAIL
X				X		Typha latifolia BROAD-LEAVED CATTAIL
	X			X		Urtica procera TALL NETTLE
	X	X				Veronica peregrina PURSLANE SPEEDWELL
X	X				X	*Viburnum oppulus EUROPEAN HIGHBUSH CRANBERRY
	X			X		Viola papilionacea COMMON BLUE VIOLET
	X			X		Viola sororia HAIRY BLUE VIOLET

= rating coefficient
= aquatic
= paludal
= moist
= annual
= biennial
= perennial
= woody
= non-native species

Table 14: Plant Species Unlikely To Volunteer in the Revegetation Process

RC	AQ	PA	MO	A	B	P	W	Plant Species
10		X				X		Aster praealtus WILLOW ASTER
10		X	X			X		Aster umbellatus FLAT-TOP ASTER
10		X				X		Boltonia latisquama recognita FALSE ASTER
15	X					X		Brasenia schreberi WATER SHIELD
9		X				X		Bromus ciliatus FRINGED BROME
15			X			X		Bromus kalmii PRAIRIE BROME
15			X			X		Cacalia tuberosa PRAIRIE INDIAN PLANTAIN
15	X	X				X		Callitriche heterophylla LARGE WATER STARWORT
10		X				X		Campanula uliginosa MARSH BELL FLOWER
10			X			X		Carex festucacea FESCUE SEDGE
10		X				X		Carex lacustris LAKE SEDGE
9		X	X			X		Carex meadii MEADE'S SEDGE
10		X				X		Carex prairea BRONZE-SHEATHED SEDGE
15		X				X		Carex retrorsa REFLEXED BEAK SEDGE
10		X				X		Carex rostrata utriculata BEAK SEDGE
10		X				X		Carex sartwellii SARTWELL'S SEDGE
10		X	X			X		Carex squarrosa SQUARROSE SEDGE
9			X			X		Carex tetanica STIFF SEDGE
10		X				X		Carex trichocarpa HAIRY LAKE SEDGE
10		X				X		Carex vesicaria monile LESSER BEAKED SEDGE
10		X				X		Cirsium muticum SWAMP THISTLE
9		X		X				Eleocharis engelmanni FALSE BLUNT SPIKE SEDGE
15		X				X		Epilobium strictum DOWNY WILLOW HERB
15		X				X		Eriophorum angustifolium NARROW-LEAVED COTTONGRASS
15		X				X		Galium trifidum SMALL BEDSTRAW
10		X		X	X			Gentiana crinita FRINGED GENTIAN
9		X		X	X			Gentiana procera SMALL FRINGED GENTIAN
9		X	X			X		Hierochloe odorata VANILLA GRASS
9		X	X			X		Juncus brachycephalus SHORT-HEADED RUSH
9		X		X				Lobelia kalmii BOG LOBELIA
9		X	X			X		Lysimachia quadriflora NARROW-LEAVED LOOSESTRIFE
9		X				X		Lysimachia thyrsiflora TUFTED LOOSESTRIFE
15		X				X		Menyanthes trifoliata minor BOG BEAN
15	X					X		Myriophyllum verticillatum pectinatum WHORLED WATER MIL
10	X					X		Nelumbo lutea LOTUS
10		X		X				Panicum flexile WIRY PANIC GRASS
9			X			X		Panicum lindheimeri SMOOTH PANIC GRASS

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist
A = annual
B = biennial
P = perennial
W = woody

le 14, continued (page 2 of 3)

AQ	PA	MO	A	B	P	W	Plant species
	X				X		Parnassia glauca GRASS OF PARNASSUS
X					X		Plantago cordata HEART-LEAVED PLANTAIN
		X				X	Platanus occidentalis SYCAMORE
	X				X		Polygonum sagittatum ARROW-LEAVED TEAR-THUMB
	X				X		Pontederia cordata PICKEREL WEED
X					X		Potamogeton amplifolius LARGE-LEAVED PONDWEED
X					X		Potamogeton friesii FRIES'S PONDWEED
X					X		Potamogeton praelongus WHITE-STEMMED PONDWEED
X					X		Potamogeton richardsonii RICHARDSON'S PONDWEED
X					X		Potamogeton robbinsii FERN PONDWEED
X					X		Potamogeton strictifolius STIFF PONDWEED
	X					X	Potentilla fruticosa SHRUBBY CINQUEFOIL
	X	X				X	Pyrus floribunda PURPLE CHOKEBERRY
	X					X	Rhamnus alnifolia ALDER BUCKTHORN
	X				X		Rhynchospora capillacea HAIR BEAK RUSH
	X		X	X			Rorippa islandica hispida HAIRY MARSH CRESS
	X					X	Rosa palustris SWAMP ROSE
	X		X				Rotala ramosior WHEELWORT
	X				X		Rubus pubescens DWARF RASPBERRY
		X			X		Rudbeckia subtomentosa SWEET BLACK-EYED SUSAN
X	X				X		Sagittaria graminea GRASS-LEAVED ARROWHEAD
X	X				X		Sagittaria rigida STIFF ARROWHEAD
	X					X	Salix candida HOARY WILLOW
	X					X	Salix gracilis textoris PETIOLED WILLOW
	X					X	Salix lucida SHINING WILLOW
	X					X	Salix serissima AUTUMN WILLOW
	X				X		Sutureja arkansana LOW CALAMINT
	X	X			X		Scleria triglomerata TALL NUT RUSH
	X		X				Scleria verticillata LOW NUT RUSH
	X				X		Selaginella apoda MARCH CLUB
	X				X		Solidago uliginosa BOG GOLDENROD
X	X				X		Sparganium chlorocarpum GREEN-FRUITED BUR REED
	X	X				X	Spiraea tomentosa rosea HARDHACK
	X					X	Thuja occidentalis ARBOR VITAE
	X				X		Tofieldia glutinosa FALSE ASPHODEL
	X				X		Triglochin martima COMMON BOG ARROW
	X				X		Triglochin palustris SLENDER BOG ARROW

rating coefficient
aquatic
paludal
moist
annual
biennial
perennial
woody

Table 14, continued (page 3 of 3)

RC	AQ	PA	MO	A	B	P	W	Plant species
15	X					X		Utricularia gibba HUMPED BLADDERWORT
15	X					X		Utricularia intermedia FLAT-LEAVED BLADDERWORT
10	X					X		Utricularia vulgaris GREAT BLADDERWORT
10		X				X		Valeriana ciliata COMMON VALERIAN
10	X	X				X		Veronica comosa WATER SPEEDWELL
10		X				X		Veronica scutellata MARSH SPEEDWELL
10			X			X		Viola conspersa DOG VIOLET
15	X					X		Wolffia punctata DOTTED WATER MEAL

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist
A = annual
B = biennial
P = perennial
W = woody

Table 15: Annual and Biennial "Discretionary" Plant Species

RC	AQ	PA	MO	Plant species
6			X	Arabis perstellata shortii TOOTHED CRESS
5		X		Bidens ceruna NODDING BUR MARIGOLD
5		X		Bidens comosa SWAMP TICKSEED
8		X		Bidens connata PURPLE-STEMMED TICKSEED
8		X		Bidens coronata TALL SWAMP MARIGOLD
4		X	X	Cardamine pensylvanica PENNSYLVANIA BITTERCRESS
5			X	Chaerophyllum procumbens WILD CHERVIL
8		X		Cicuta bulbifera BULBLET-BEARING WATER HEMLOCK
8		X		Cicuta maculata WATER HEMLOCK
6		X	X	Cusuta cephalanthi BUTTONBUSH DODDER
7		X	X	Cuscuta glomerata ROPE DODDER
4		X	X	Cuscuta gronovii COMMON DODDER
7		X	X	Cyperus inflexus BRISTLY CYPERUS
4		X	X	Cyperus rivularis BROOK SEDGE
5		X	X	Echinochloa walteri SALT-MARSH COCKSPUR GRASS
8		X		Eleocharis intermedia MATTED SPIKE RUSH
5		X		Eleocharis obtusa BLUNT SPIKE RUSH
7		X	X	Eragrostis frankii SANDBAR LOVE GRASS
7		X	X	Gerardia paupercula LESSER PURPLE FALSE FOXGLOVE
7		X	X	Gerardia purpurea PURPLE FALSE FOXGLOVE
7		X	X	Gerardia tenuifolia SLENDER FLASE FOXGLOVE
5		X	X	Gratiola neglecta CLAMMY HEDGE HYSSOP
6		X	X	Lindernia dubia FALSE PIMPERNEL
4			X	Lobelia inflata INDIAN TOBACCO
4			X	Parietaria pensylvanica PELLITORY
7		X	X	Pilea fontana BOG CLEARWEED
5		X	X	Pilea pumila COMMON CLEARWEED
6		X		Polygonum punctatum SMARTWEED
6		X		Ranunculus pensylvanicus BRISTLY BUTTERCUP
6		X		Ranunculus sceleratus CURSED BUTTERCUP
5		X		Rorippa islandica fernaldiana MARSH CRESS
6		X		Samolus parviflorus WATER PIMPERNEL

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist

Table 16: Perennial "Discretionary" Plant Species

RC	AQ	PA	MO	Plant species
7		X		Acorus calamus SWEET FLAG
8		X	X	Agrimonia parviflora SWAMP AGRIMONY
6		X		Agrostis alba palustris CREEPING BENT
4		X		Alisma subcordatum COMMON WATER PLANTAIN
4		X		Alisma triviale LARGE-FLOWERED WATER PLANTAIN
6		X		Alopecurus aequalis SHORT-AWNED FOXTAIL
4			X	Amphicarpa bracteata HOG PEANUT
4		X	X	Amphicarpa bracteata comosa HOG PEANUT
4			X	Andropogon gerardi BIG BLUE STEM
5		X		Angelica atropurpurea GREAT ANGELICA
6		X	X	Apios americana GROUND NUT
6			X	Arabis perstellata shortii TOOTHED CRESS
4		X		Asclepias incarnata SWAMP MILKWEED
4		X	X	Aster novae-angliae NEW ENGLAND ASTER
6		X		Aster puniceus SWAMP ASTER
5		X		Aster puniceus firmus SWAMP ASTER
5		X	X	Calamagrostis inexpansa brevior BOG REED GRASS
5		X		Caltha palustris MARSH MARIGOLD
7		X		Campanula aparinoides MARSH BELLFLOWER
5		X		Cardamine bulbosa BULBOUS CRESS
6			X	Cardamine douglassii PURPLE SPRING CRESS
4		X	X	Cardamine pensylvanica PENNSYLVANIA BITTER CRESS
8		X	X	Carex albolutescens WHITISH-YELLOW CAREX
8		X	X	Carex alopecoidea FALSE HEAVY SEDGE
7			X	Carex annectens xanthocarpa YELLOW FOX SEDGE
5		X		Carex aquatilis altior BLUE MEADOW SEDGE
8		X		Carex buxbaumii BUXBAUM'S SEDGE
5		X		Carex comosa BRISTLY SEDGE
4		X	X	Carex cristatella SMALL CRESTED SEDGE
5			X	Carex davisii DAVIS' SEDGE
8		X		Carex emoryi FALSE MEADOW SEDGE
5		X	X	Carex granularis HALE'S SEDGE
7			X	Carex grayii BUR SEDGE
6		X		Carex haydenii LONG-SCALED MEADOW SEDGE
4		X		Carex hystricina BOTTLEBRUSH SEDGE
4		X	X	Carex lanuginosa WOOLLY SEDGE
8		X		Carex lasiocarpa americana FALSE WOOLLY SEDGE
8		X	X	Carex lupulina HOP SEDGE
5		X	X	Carex normalis RIGHT-ANGLED SEDGE
5		X		Carex stricta MEADOW SEDGE
8		X		Carex suberecta TUSSOCK SEDGE

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist

Table 16, continued (page 2 of 5)

RC	AQ	PA	MO	Plant species
8			X	Carex tenera LESSER FESCUE SEDGE
5	X			Ceratophyllum demersum COONTAIL
8		X		Chelone glabra TURTLEHEAD
8		X		Cicuta bulbifera BULBLET-BEARING WATER HEMLOCK
8		X		Cicuta maculata WATER HEMLOCK
5			X	Cinna arundinacea COMMON WOOD REED
8	X	X		Decodon verticillatus SWAMP LOOSESTRIFE
6			X	Dodecatheon meadia SHOOTING STAR
6		X		Dryopteris thelypteris pubescens MARSH SHIELD FERN
5		X	X	Echinocystis lobata WILD CUCUMBER
6		X		Eleocharis acicularis NEEDLE SPIKE RUSH
5		X		Eleocharis calva RED-ROOTED SPIKE RUSH
5		X		Eleocharis compressa FLAT-STEMMED SPIKE RUSH
8		X		Eleocharis elliptica NORTHERN SPIKE RUSH
5		X		Eleocharis palustris major SWAMP SPIKE RUSH
5		X		Eleocharis smallii FALSE SWAMP SPIKE RUSH
5	X			Elodea canadensis COMMON WATERWEED
7	X			Elodea nuttallii SLENDER WATERWEED
5			X	Elymus riparius RIVERBANK WILD RYE
5			X	Elymus villosus SILKY WILD RYE
4			X	Elymus virginicus VIRGINIA WILD RYE
8		X		Epilobium leptophyllum FEN WILLOW HERB
7		X		Equisetum fluviatile PIPES
5		X		Eragrostis hypnoides CREEPING LOVE GRASS
4			X	Erigeron philadelphicus MARSH FLEABANE
5		X		Eupatorium maculatum SPOTTED JOE PYE WEED
6		X		Eupatorium perfoliatum COMMON BONESET
7		X	X	Galium boreale NORTHERN BEDSTRAW
5		X	X	Galium obtusum WILD MADDER
8		X		Galium tinctorium STIFF BEDSTRAW
7			X	Gentiana andrewsii CLOSED GENTIAN
7			X	Geum alepicum strictum YELLOW AVENS
8	X	X		Glyceria septentrionalis FLOATING MANNA GRASS
4		X	X	Glyceria striata FOWL MEADOW GRASS
5			X	Helenium autumnale SNEEZEWEED
5			X	Heracleum maximum COW PARSNIP
8	X	X		Heteranthera dubia WATER STAR GRASS
5			X	Humulus lupulus COMMON HOP
8		X	X	Hypericum majus GREATER NORTHERN ST. JOHN'S WORT
8		X		Hypericum virginicum fraseri MARSH ST. JOHN'S WORT
5		X		Iris virginica shrevei BLUE FLAG
8		X	X	Juncus acuminatus SHARP-FRUITED RUSH

C = rating coefficient
Q = aquatic
A = paludal
O = moist

Table 16, continued (page 3 of 5)

RC	AQ	PA	MO	Plant species
7		X	X	Juncus canadensis CANADIAN RUSH
4			X	Juncus dudleyi DUDLEY'S RUSH
7		X		Juncus effusus solutus COMMON RUSH
6		X	X	Juncus nodosus JOINT RUSH
4		X	X	Juncus torreyi TORRY'S RUSH
8		X		Lathyrus palustris MARSH VETCHLING
6		X		Lathyrus palustris myrtifolius SLENDER MARSH VETCHLING
5		X		Leersia oryzoides RICE CUT GRASS
7			X	Leersia virginica WHITE GRASS
5	X			Lemna minor SMALL DUCKWEED
7	X			Lemna trisulca FORKED DUCKWEED
6		X	X	Liatris spicta MARSH BLAZING STAR
6		X	X	Lilium michiganense MICHIGAN LILY
7			X	Liparis loeselii GREEN TWAYBLADE
6			X	Lippia lanceolata recognita FOG FRUIT
7		X		Lobelia cardinalis CARDINAL FLOWER
6		X	X	Lobelia siphilitica GREAT BLUE LOBELIA
6		X	X	Lobelia spicata PALE-SPIKED LOBELIA
5		X		Ludwigia palustris americana MARSH PURSLANE
6		X		Ludwigia polycarpa FALSE LOOSESTRIFE
5		X		Lycopus americanus COMMON WATER HOREHOUND
6		X		Lycopus uniflorus NORTHERN BUGLE WEED
6		X		Lycopus virginicus BUGLE WEED
4		X	X	Lysimachia ciliata FRINGED LOOSESTRIFE
8		X		Lysimachia terrestris SWAMP CANDLES
7		X		Lythrum alatum WINGED LOOSESTRIFE
5		X		Mentha arvensis villosa WILD MINT
6		X		Mimulus ringens MONKEY FLOWER
7		X		Muhlenbergia glomerata MARSH WILD TIMOTHY
5		X	X	Muhlenbergia mexicana LEAFY SATIN GRASS
7	X			Myriophyllum exalbescens SPIKED WATER MILFOIL
6	X			Naias flexilis SLENDER NAIAD
7	X			Nuphar advena YELLOW POND LILY
8	X			Nuphar variegatum YELLOW POND LILY
7	X			Nymphaea tuberosa WHITE WATER LILY
8		X		Onoclea sensibilis SENSITIVE FERN
6		X	X	Osmunda cinnamomea CINNAMON FERN
7		X	X	Osmunda claytoniana INTERRUPTED FERN
8		X		Osmunda regalis spectabilis ROYAL FERN
7		X		Oxypolis rigidior COWBANE
5			X	Panicum virgatum SWITCH GRASS

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist

Table 16, continued (page 4 of 5)

RC	AQ	PA	MO	Plant species
7		X		Pedicularis lanceolata SWAMP BETONY
5		X		Penthorum sedoides DITCH STONECAP
7		X	X	Phlox glaberrima interior MARSH PHLOX
4		X		Phragmites communis berlandieri COMMON REED
7		X		Physostegia virginiana speciosa FALSE DRAGONHEAD
5	X	X		Polygonum amphibium stipulaceum WATER KNOTWEED
5	X	X		Polygonum coccineum WATER HEARTSEASE
7		X		Polygonum hydropiperoides MILD WATER PEPPER
6		X		Polygonum punctatum SMARTWEED
8	X			Potamogeton diversifolius WATERTHREAD
7	X			Potamogeton foliosus LEAFY PONDWEED
7	X			Potamogeton gramineus GRASS-LEAVED PONDWEED
7	X			Potamogeton illinoensis ILLINOIS PONDWEED
7	X			Potamogeton natans COMMON PONDWEED
7	X			Potamogeton nodosus LONG-LEAVED PONDWEED
6	X			Potamogeton pectinatus SAGO PONDWEED
7	X			Potamogeton pusillus SMALL PONDWEED
8	X			Potamogeton zosteriformis FLAT-STEMMED PONDWEED
6	X	X		Proserpinaca palustris crebra MERMAID WEED
5		X	X	Pycnanthemum virginianum COMMON MOUNTAIN MINT
7	X			Ranunculus flabellaris YELLOW WATER CROWFOOT
8		X		Ranunculus hispidus ROUGH BUTTERCUP
8	X			Ranunculuis longirostris STIFF WATER CROWFOOT
6		X		Ranunculus pensylvanicus BRISTLY BUTTERCUP
5			X	Ranunculus recurvatus HOOKED BUTTERCUP
6		X		Ranunculus sceleratus CURSED BUTTERCUP
7		X		Rumex orbiculatus GREAT WATER DOCK
6		X	X	Rumex verticillatus SWAMP DOCK
8	X	X		Sagittaria cuneata ARUM-LEAVED ARROWHEAD
4	X	X		Sagittaria latifolia COMMON ARROWHEAD
6		X		Samolus parviflorus WATER PIMPERNEL
8		X		Saxifraga pensylvanica SWAMP SAXIFRAGE
6		X		Scirpus acutus HARD-STEMMED BULRUSH
7		X		Scirpus americanus CHAIRMAKER'S RUSH
4		X	X	Scirpus atrovirens DARK GREEN RUSH
6		X		Scirpus cyperinus WOOL GRASS
6		X		Scirpus fluviatilis RIVER BULRUSH
4		X	X	Scirpus lineatus RED BULRUSH
5		X		Scirpus validus creber GREAT BULRUSH
5		X		Scutellaria epilobiifolia MARSH SKULLCAP
5		X		Scutellaria lateriflora MAD-DOG SKULLCAP

RC = rating coefficient
AQ = aquatic
PA = paludal
MO = moist

72-101

PORT DOCUMENTATION PAGE	1. REPORT NO. 82/09	2.	3. Recipient's Accession No.
Title and Subtitle			5. Report Date May, 1982
Creation of Wetland Habitats in Northeastern Illinois			6.
Author(s) Donald L. Hey, Judith M. Stockdale, David Kropp, Gerould Wilhelm			8. Performing Organization Rept. No.
Performing Organization Name and Address Resource Associates 53 W. Jackson Boulevard Chicago, IL 60604			10. Project/Task/Work Unit No. 20.146 11. Contract(C) or Grant(G) No. (C) (G)
Sponsoring Organization Name and Address IL Department of Energy & Natural Resources 325 W. Adams Springfield, IL 62706			13. Type of Report & Period Covered 14.

Supplementary Notes

Prepared in association with the Open Lands Project and the Kropp Company.

Abstract (Limit: 200 words)

The work presented in this report addressed the problems of: 1) loss of wetland and aquatic habitats; 2) reduced flood water storage capacity; 3) treatment of non-point source pollution; 4) the cost of high technology, advanced wastewater treatment; and 5) limited enjoyment and use of cleaner streams. It investigates the role of re-established wetlands as a potential solution to these urban problems. A conceptual plan is proposed for wetland restoration on a specific site along the Des Plaines River in northeastern Illinois.

Document Analysis a. Descriptors

Water Pollution
Water Quality
Flood Prevention

. Identifiers/Open-Ended Terms

Wetlands
Non-Point Source Pollution

COSATI Field/Group

Availability Statement:	19. Security Class (This Report)	21. No. of Pages
o restriction on distribution. Available at IL epository libraries or from the National Technica nformation Service, Springfield, VA 22161	unclassified	123
	20. Security Class (This Page) unclassified	22. Price

ISI–Z39.18)

OPTIONAL FORM 272 (4–77)
(Formerly NTIS–35)
Department of Commerce